



Release 6.1 - User Manual

Copyright

© brown-iposs GmbH 2015

Copyright at brown-iposs GmbH. All rights reserved. Translation, reprinting, copying of illustrations, broadcasting, photo-mechanical or similar reproduction always requires the permission by brown-iposs GmbH. Storage, also on data-processing systems, even of parts, is allowed only for documenting. As long as not otherwise indicated this document and all of its parts are confidential and might not be distributed to third parties.

Label

WiMAP-4G is a registered label of brown-iposs GmbH.

Contents

ABOUT THIS MANUAL	10
CONVENTIONS	10
TECHNICAL ASSISTANCE.....	11
1 INTRODUCTION	12
1.1 WiMAP-4G	12
1.2 WiMAP-4G EDITIONS.....	12
1.2.1 <i>WiMAP-4G Community-Edition</i>	12
1.2.2 <i>WiMAP-4G Professional-Edition</i>	13
1.3 SYSTEM REQUIREMENTS	14
1.4 INSTALLATION	15
1.4.1 <i>How to Install WiMAP-4G</i>	15
1.5 LAUNCHING WiMAP-4G FOR THE FIRST TIME	16
1.5.1 <i>Get a License for the Professional-Edition</i>	17
1.5.2 <i>Get a License for the Community-Edition</i>	17
1.6 GLOBAL SETTINGS	18
2 FIRST STEPS.....	23
2.1 THE FIRST PROJECT	23
2.2 WORK AREA	25
2.2.1 <i>Work Area Basics</i>	25
2.2.2 <i>Elements of the Control-Bar</i>	26
2.2.3 <i>The Rectangle Zoom Tool</i>	28
2.2.4 <i>The Distance/Measurement Tool</i>	29
2.2.5 <i>The Terrain-Profiler</i>	30
2.2.5.1 <i>How to Use the Terrain-Profiler</i>	30
2.2.5.2 <i>Configuring the Terrain-Profiler</i>	32
2.2.5.3 <i>Additional Terrain-Profiler Zoom</i>	35
2.2.5.4 <i>Terrain-Profiler Export Features</i>	36
2.3 CUSTOMIZING THE WORK AREA.....	37
2.3.1 <i>Transfix the Windows</i>	37
2.3.2 <i>Adjustment and Zoom Customization</i>	38
2.4 THE PROJECT-EXPLORER	39
2.4.1 <i>The Sites Tab</i>	40
2.4.2 <i>The Layers Tab</i>	40
2.4.3 <i>The Points Tab</i>	42
2.4.4 <i>The Calculation Tab</i>	43
2.4.5 <i>The Elevation Model Tab</i>	44
2.4.6 <i>The Cadastral Data Tab</i>	45
2.4.7 <i>The Clients Tab</i>	45
2.4.8 <i>The Link Budget Tab</i>	46
3 PROJECTS	47
3.1 PROJECT SETTINGS.....	47

3.1.1	<i>General</i>	47
3.1.2	<i>Calculation</i>	47
3.1.2.1	Themes	49
3.1.2.1.1	How to Change a Colour Profile	50
3.1.2.1.2	How to Add a New Colour Profile	51
3.1.2.2	Empirical Models	52
3.1.2.2.1	Free Space Propagation	54
3.1.2.2.1.1	How to Add a New Frequency Dependent Parameter for Free Space Propagation	55
3.1.2.2.2	ITU-R P.1411-3	56
3.1.2.2.3	Erceg Model	57
3.1.2.2.4	Visibility	58
3.1.2.2.4.1	How to Add a New Frequency Dependent Parameter for Building Intersection	59
3.1.2.3	CORLA (Raylauncher)	60
3.1.2.3.1	Algorithm	61
3.1.2.3.2	Model Parameters	62
3.1.2.4	WinProp	63
3.1.3	<i>Elevation Model</i>	63
3.1.4	<i>DXF</i>	64
3.1.5	<i>Building Classes</i>	64
3.1.5.1	How to Add a Building or Wood Profile	65
3.2	CREATE PROJECTS	67
3.2.1	<i>Create Preconfigured Projects</i>	68
3.2.1.1	How to Create a Preconfigured Project	69
3.2.1.1.1	How to Find Specific Geographic Coordinates with Google Maps™	72
3.2.2	<i>Create Empty Projects</i>	73
3.2.2.1	How to Create an Empty Project	73
3.3	LOAD PROJECTS	74
3.4	SAVE PROJECTS	75
3.5	THE LOG	75
4	GEODATA	76
4.1	CADASTRAL DATA	76
4.1.1	<i>How to Import Cadastral Data</i>	76
4.1.2	<i>DXF Settings</i>	78
4.1.2.1	How to Edit Cadastral Data Layers	79
4.2	ELEVATION MODELS	81
4.2.1	<i>How to Import an Elevation Model</i>	81
4.2.2	<i>How to Reload an Elevation Model from Web</i>	82
4.3	BACKGROUND IMAGES	83
4.3.1	<i>How to Import a Background Image</i>	84
4.4	LOCATION IMAGES	84
4.4.1	<i>How to Import a Location Image/Images</i>	85
4.4.2	<i>How to View a Location Image/Images</i>	87
4.4.3	<i>How to Delete a Location Image/Images</i>	88
4.4.4	<i>How to Import as Background Image</i>	89
5	BUILDINGS	91
5.1	CREATE BUILDINGS	92
5.1.1	<i>How to Create Buildings</i>	92
5.1.2	<i>Advanced Buildings</i>	96

5.1.2.1	How to Create Courtyard or Similar in Buildings	96
5.1.2.2	How to Add Intersecting Buildings	97
5.2	EDIT BUILDINGS	99
5.2.1	<i>How to Edit a Building</i>	99
5.3	EXPORT BUILDINGS	99
5.3.1	<i>How to Export Buildings</i>	100
5.4	IMPORT BUILDINGS	100
5.4.1	<i>How to Import Buildings</i>	100
5.5	CREATE BUILDINGS USING CADASTRAL DATA (PROFESSIONAL-EDITION)	101
5.5.1	<i>How to Create Buildings Using Cadastral Data</i>	101
5.6	CREATE BUILDINGS USING CORINE (PROFESSIONAL-EDITION)	102
5.6.1	<i>How to Create Buildings Using CORINE Data</i>	102
5.7	DELETE BUILDINGS	105
5.7.1	<i>How to Delete Building manually</i>	105
5.8	CLEAR BUILDING CACHE	105
5.8.1	<i>How to Clear Building Cache</i>	106
6	CARRIER	107
6.1	HOW TO CREATE OR EDIT CARRIER	108
6.2	IMPORT CARRIER	111
6.2.1	<i>How to Import Carrier</i>	111
7	SITES, RADIO UNITS AND ANTENNAS	113
7.1	ANTENNAS	113
7.1.1	<i>Create Antennas</i>	113
7.1.1.1	How to Create Antennas	113
7.1.1.2	How to Create Antenna Types	115
7.1.2	<i>Editing Antennas</i>	118
7.1.2.1	How to Edit Antennas	118
7.1.2.2	How to Edit Antenna Types	120
7.1.3	<i>How to Copy Antennas</i>	121
7.1.4	<i>How to Change all Antennas Faster</i>	122
7.1.5	<i>How to Create a Pattern File</i>	123
7.1.6	<i>Export Antennas</i>	127
7.1.6.1	How to Export Antennas	127
7.1.7	<i>Import Antennas</i>	127
7.1.7.1	How to Import Antennas	128
7.1.7.2	How to Import Antenna Types	129
7.1.8	<i>Activate or Deactivate Antennas</i>	130
7.1.8.1	How to Activate/Deactivate Antennas	130
7.1.8.2	How to Invert Activation	131
7.1.8.3	How to Activate Antennas by a Filter	131
7.1.9	<i>Invalid Antennas</i>	132
7.1.10	<i>Distributed/MIMO Antennas</i>	135
7.1.10.1	How to Create Distributed/MIMO Antennas	135
7.2	RADIO UNITS	137
7.2.1	<i>How to Create a Radio Unit</i>	138
7.2.2	<i>How to Edit a Radio Unit</i>	139
7.2.3	<i>How to Copy a Radio Unit</i>	140

7.2.4	<i>How to Change Carrier in a Radio Unit.....</i>	142
7.2.5	<i>How to Change Radio Units faster.....</i>	144
7.2.6	<i>Activate or Deactivate Radio Units.....</i>	144
7.2.6.1	<i>How to Activate or Deactivate Radio Units at once.....</i>	145
7.2.6.2	<i>How to Activate or Deactivate Radio Units manually.....</i>	145
7.2.6.3	<i>How to Invert Activation.....</i>	146
7.3	SITES	146
7.3.1	<i>How to Create Sites</i>	146
7.3.2	<i>How to Edit Sites.....</i>	152
7.3.3	<i>How to Copy Sites</i>	154
7.3.4	<i>Activate or Deactivate Sites.....</i>	156
7.3.4.1	<i>How to Activate or Deactivate all Sites at Once</i>	156
7.3.4.2	<i>How to Activate or Deactivate Sites Manually</i>	157
8	POINTS.....	158
8.1	MEASUREMENT POINTS	158
8.2	POINT CATEGORIES.....	160
8.2.1	<i>How to Edit Point Categories.....</i>	161
8.2.2	<i>How to Create a Point Category.....</i>	162
8.3	CREATE POINTS.....	164
8.3.1	<i>How to Create Points.....</i>	164
8.3.2	<i>How to Edit Single Points.....</i>	166
8.3.3	<i>How to Edit Multiple Points.....</i>	167
8.4	POINT ACTIVATION	168
8.4.1	<i>How to Activate or Deactivate Points.....</i>	168
8.5	EXPORT AND IMPORT OF POINTS.....	169
8.5.1	<i>How to Export Points as .csv file.....</i>	169
8.5.2	<i>How to Export Points as .kml file</i>	170
8.5.3	<i>How to Import Points.....</i>	171
8.6	POINTS COLOUR ASSIGNMENT	172
8.6.1	<i>How to Change the Colour of a Point manually</i>	173
8.6.2	<i>Change Colour of Points temporary by Visualisation tab.....</i>	173
8.6.3	<i>Change Colour of Points by Coverage tab</i>	173
8.6.4	<i>Change Colour of Points according to Theme Calculation.....</i>	174
8.7	CLIENTS AND POINTS.....	174
8.7.1	<i>How to Create Clients from Points.....</i>	175
8.7.2	<i>How to Convert Clients to Points</i>	176
8.8	POINT PARAMETERS	178
8.8.1	<i>How to Assign carrier.....</i>	178
9	CLIENTS.....	179
9.1	CLIENT PROFILES	179
9.1.1	<i>How to Create Client Profiles.....</i>	179
9.1.2	<i>How to Edit Client Profiles</i>	181
9.2	CLIENT CREATION.....	182
9.2.1	<i>How to Create Clients</i>	182
9.3	EDIT CLIENTS	184

9.3.1	<i>How to Edit Clients</i>	184
9.4	ASSIGN CLIENTS TO SITES.....	186
9.4.1	<i>How to Assign Clients to Sites</i>	186
9.5	HOW TO USE THE TERRAIN-PROFILER FOR CLIENT TO SITE.....	186
9.6	INVALID CLIENTS	187
10	CALCULATIONS AND THEMES	188
10.1	CALCULATIONS AND THEME TYPES.....	188
10.2	THE FIELD STRENGTH AREA CALCULATION	189
10.2.1	<i>How to Make a Field Strength Area Calculation</i>	189
10.2.1.1	With the Erceg Model	190
10.2.1.2	With the CORLA Raylauncher Model.....	192
10.2.1.3	With the ITU-R P.1411-3 Model	193
10.2.1.4	With the Free Space Propagation Model	194
10.2.1.5	With WinProp.....	195
10.2.1.6	General Settings	196
10.3	THE CLIENT COVERAGE CALCULATION	196
10.3.1	<i>How to Make a Client Coverage Calculation</i>	197
10.3.1.1	With the Erceg Model	198
10.3.1.2	With the CORLA Raylauncher Model.....	200
10.3.1.3	With the ITU-R P.1411-3 Model	201
10.3.1.4	With the Free Space Propagation Model	202
10.3.1.5	With WinProp.....	203
10.4	THE POINT FIELD STRENGTH CALCULATION	204
10.4.1	<i>How to Make a Point Field Strength Calculation</i>	206
10.4.1.1	With the Erceg Model	207
10.4.1.2	With the CORLA Raylauncher Model.....	209
10.4.1.3	With the ITU-R P.1411-3 Model	211
10.4.1.4	With the Free Space Propagation Model	212
10.4.1.5	With WinProp.....	213
10.4.1.6	General Settings	214
10.4.2	<i>Compare all Propagation Models</i>	214
10.4.2.1	How to Use all Propagation Models for a Point Field Strength Calculation	214
10.5	THE SITE TO SITE CALCULATION.....	217
10.5.1	<i>How to Make a Site to Site Calculation</i>	217
10.6	THE COVERAGE THEME.....	219
10.6.1	<i>How to Create a Coverage Theme</i>	220
10.7	THE BEST SERVER THEME.....	223
10.7.1	<i>How to Create a Best Server Theme</i>	223
10.8	THE CARRIER TO INTERFERER THEME	226
10.8.1	<i>How to Create a Carrier to Interferer Theme</i>	227
10.9	THE POWER LEVEL THEME	231
10.9.1	<i>How to Create a Power Level Theme</i>	231
10.10	THE SUB-CARRIER INTERFERENCE THEME	234
10.10.1	<i>How to Create a Sub-Carrier Interference Theme</i>	235
10.11	THE FIELD STRENGTH THEME.....	239
10.11.1	<i>How to Create a Field Strength Theme</i>	239
10.12	THE ELEVATION THEME	243
10.12.1	<i>How to Create an Elevation Theme</i>	244

10.13	THE VISIBILITY THEME	245
10.13.1	How to Create a Visibility Theme	246
10.13.1.1	How to Clear the Visibility Cache	247
10.14	EXPORT CALCULATION THEME	248
10.14.1	How to Export a Theme	248
10.15	CLEAR AND DELETE CALCULATION	250
10.15.1	How to Clear the Calculation and Theme Layer	251
10.15.2	How to Delete the Calculation	251
10.16	CALCULATION WITH DESIRED/MIMO ANTENNAS	253
10.16.1	How to Create a Power Level Theme with Desired/MIMO Antennas	253
11	ISOLINES	255
11.1	THEME ISOLINES	255
11.1.1	How to Create Theme Isolines	255
11.2	ELEVATION ISOLINES	257
11.2.1	How to Create Elevation Isolines	257
11.3	ISOLINE EXPORT	258
11.3.1	How to Export Isolines as MIF	259
11.3.2	How to Export Isolines as KML	259
12	ADDITIONAL FUNCTIONS	261
12.1	SHOW ON GOOGLE MAPS™	261
12.1.1	How to Use the function Show on Google Maps	261
12.2	ACTIVATION/DEACTIVATION	261
12.2.1	How to Activate und Deactivate Layers	261
12.3	COLOUR	263
12.3.1	How to Make a Site coloured	263
12.3.2	How to Make a Radio Unit coloured	264
12.3.3	How to Make an Antenna coloured	265
12.3.4	How to Make a Point coloured	265
13	LINK BUDGET	266
13.1	HOW TO MAKE A LINK BUDGET CALCULATION	267
13.1.1	Manually	268
13.1.2	Automatically by Using the Terrain-Profiler	268
14	3D VIEW	272
14.1	HOW TO CREATE A 3D VIEW	272
14.2	NAVIGATE THE 3D-VIEW	273
14.2.1	Navigation Specials	274
14.3	EXPORT A 3D VIEW	275
14.3.1	How to Export a 3D View	275
15	GLOSSARY	276
16	FAQ	281
16.1.1	What is WiMAP-4G?	281
16.1.2	Does WiMAP-4G supports 64-bit operating systems?	281
16.1.3	Which languages does WiMAP-4G support?	281
16.1.4	Do I have to be online to use WiMAP-4G?	281
16.1.5	What file formats does WiMAP-4G support?	281

16.1.6	<i>How much does WiMAP-4G cost?</i>	<i>282</i>
16.1.7	<i>What is the difference between WiMAP-4G Editions?</i>	<i>282</i>
16.1.8	<i>What are the requirements to get a license?</i>	<i>282</i>
16.1.9	<i>Can I upgrade my Community-Edition to Professional-Edition at a later date within the program?.....</i>	<i>282</i>
16.1.10	<i>Do I have to update my WiMAP-4G from time to time?.....</i>	<i>282</i>
17	TROUBLESHOOTING	283
18	IMAGE DIRECTORY	287

About this Manual

This user manual describes the setup and operation of the WiMAP-4G software. The WiMAP-4G user manual requires a basic understanding of the Windows operating system. If you are not familiar with this system, refer to the documentation provided by Microsoft.

Newcomer of WiMAP-4G software should read

- Chapter 1 to learn about the program, requirements and installation
- Chapters 2 and 3 to learn about WiMAP-4G essentials

Conventions

Convention	Notice Type	Use
<i>Italic</i>		User actions
Bold		Marks user interface elements such as buttons, menus, label, tabs
	Caution	Describes important features, instructions or limitations
	Tipp	Highlights features or hints that can save time and prevent difficulties
	Step by Step	Step by step explanation
	Info	Additional information

Technical Assistance

For technical questions or problem solving assistance, *read the section which is related to your performing operation.*

If additional assistance is needed, *contact the brown-iposs support.*

Have following information ready for the brown-iposs support to detect a problem:

- any error messages
- details of recent system performance
- WiMAP-4G version number (can be found under Help→Info)
- operating system on your computer

1 Introduction

1.1 WiMAP-4G

WiMAP-4G is the radio network planning software by brown-iposs. It is developed particularly for planning the air interface of wireless broadband access networks, e.g. based on WiMAX and WLAN standard. Also other carriers are supported. The software is Java-based and able to run on every modern standard computer. WiMAP-4G is suitable for both, beginners as well as experienced users and offers sufficient possibilities to plan even the largest projects.

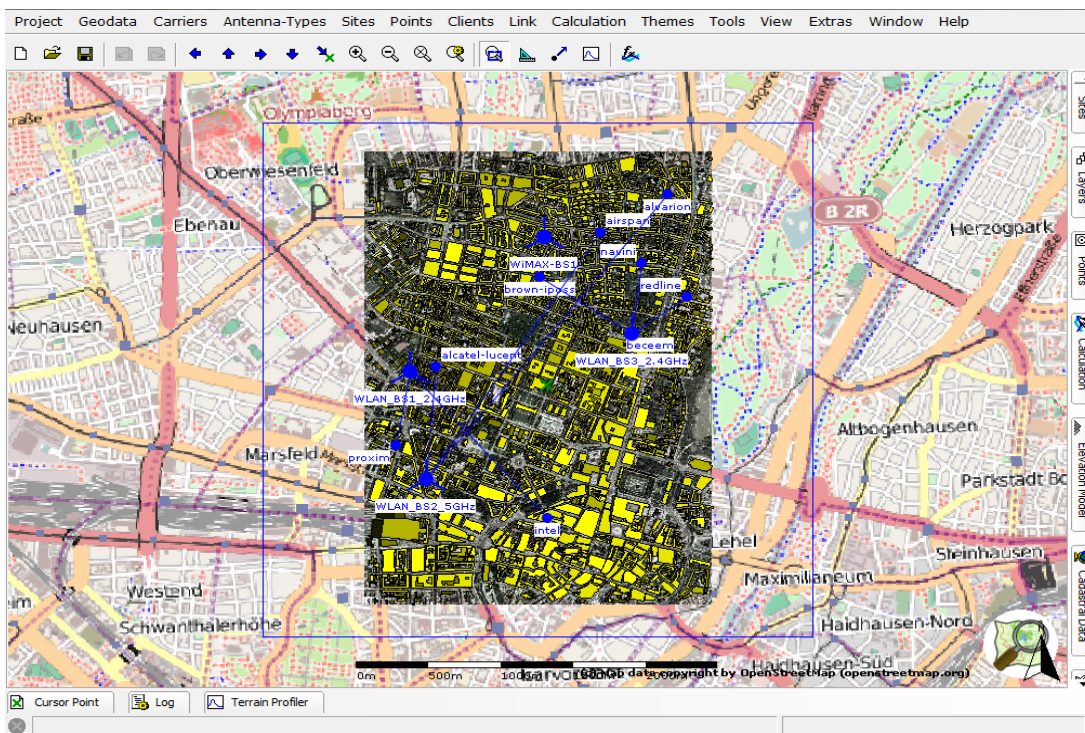


Figure 1: The WiMAP-4G working interface

1.2 WiMAP-4G Editions

Currently there are two different versions of WiMAP-4G available. The Professional-Edition offers additional features and supports more objects in the same project.

1.2.1 WiMAP-4G Community-Edition

The WiMAP-4G Community-Edition is a free version, which contains most of the functionality, but with specific restrictions.

Features of the Community-Edition:

- a configurable and clean interface

- easy generation of new projects
- import of cadastral data
- import of elevation models
- lists buildings and wood
- provides a large number of different antennas
- constructing clients and points
- measurement points
- import of location images
- extensive calculation options
- many different themes
- a 3D view of the terrain
- the Terrain-Profiler to keep track of the area
- detailed calculations with the link budget
- isolines
- export of isolines
- propagation models
 - Erceg model (provides three different patterns or individual creation)
 - ITU-R P.1411-3
 - Free Space Propagation



The Community-Edition allows a maximum of 12 radio stations and 50 points of the same type within one project. Moreover, it is not possible to use the highest accuracy level for calculations. Some import and export functions are working in the Professional-Edition only. This version is a sample of the software which gives the user an opportunity to try it out without having to purchase a complete version. It is completely suitable for smaller projects.

1.2.2 WiMAP-4G Professional-Edition

The WiMAP-4G Professional-Edition is the chargeable version of the program. It contains all functions of the WiMAP-4G Community-Edition including the following additional features:

- generates buildings and wood from cadastral data
- imports CORINE data
- provides calculations with the highest accuracy

- CORLA-Raylauncher (Cube Oriented Ray Launching Algorithm) as an additional propagation model
- WinProp as an additional propagation model
- large selection of antenna patterns
- extended export formats

The WiMAP-4G Professional-Edition offers high flexibility and delivers additional tools for planning carrier networks.



Figure 2: The Professional-Edition offers CORLA as an additional propagation model.

1.3 System Requirements

WiMAP-4G is a Java based software and therefore compatible with every windows operating system. 64-bit systems are supported, too.

Minimum system requirements:

- Operating System: Windows XP/7/8 or similar (has to be windows)
- Computer Processor: Pentium III with at least 1 GHz or equivalent
- Computer Memory: 2048 MB or more
- Internet: connection is required to get a license file (Community-Edition) and to use OpenStreetMap™



Since WiMAP-4G is Java-based, other platforms may be supported on request. A 64-bit-Java-Runtime-Environment is included in WiMAP-4G.

1.4 Installation

On <http://www.brown-iposs.com/en/wimap4g/download.php> you will find all required installation files, a list of features and the WiMAP-4G software license agreement.

The windows installer file WiMAP-4G Professional-/Community-Edition is required for installation. It is a zip file which needs to be unzipped before the installation.



1.4.1 How to Install WiMAP-4G

1. *Unzip the downloaded **WiMAP-4G-v6_1_0-setupNN.zip**. (NN=32 or 64 according to your choice)*
2. *Start installation by double-clicking the extracted **setup.exe**.*



Figure 3: Installation has been started

3. *Choose **installation directory**.*

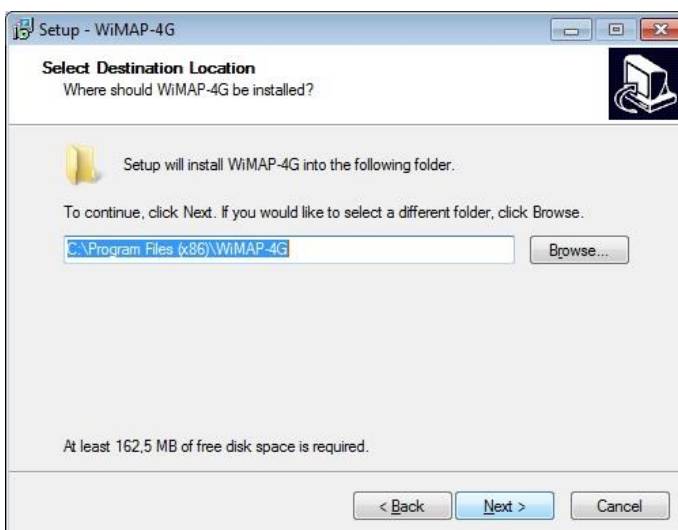


Figure 4: Installation directory

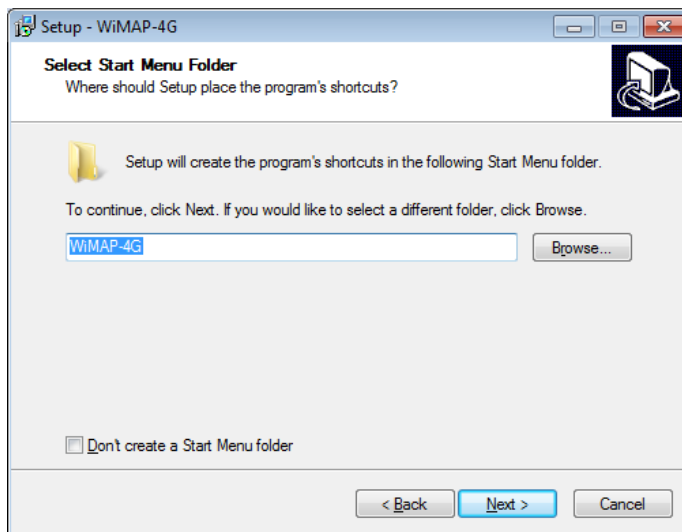


Figure 5: Start menu folder selection

4. *Select program icon locations.*

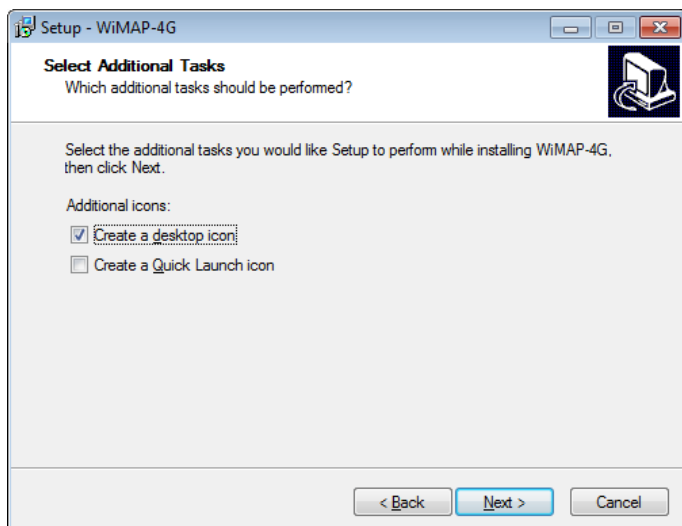


Figure 6: Program icon location

5. *Click **Next** to start installation.*

1.5 Launching WiMAP-4G for the First Time

After the installation is completed successfully, the program can be started for the first time.

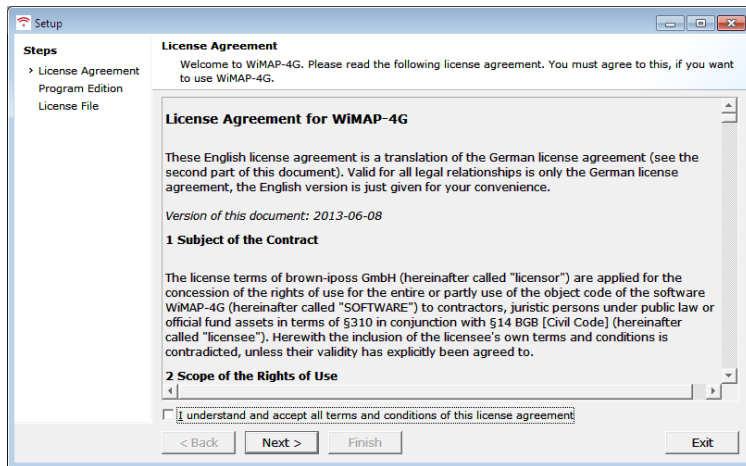


Figure 7: License agreement

WiMAP-4G needs a license to run. There are licenses for Community-Edition and Professional-Edition. For using the Community-Edition, a name and a valid e-mail address are sufficient. A license file is send by e-mail and is available immediately.

1.5.1 Get a License for the Professional-Edition



A license for the Professional-Edition can be purchased later. To run the Professional-Edition an USB-Dongle is needed, which is provided by brown-iposs.

1.5.2 Get a License for the Community-Edition

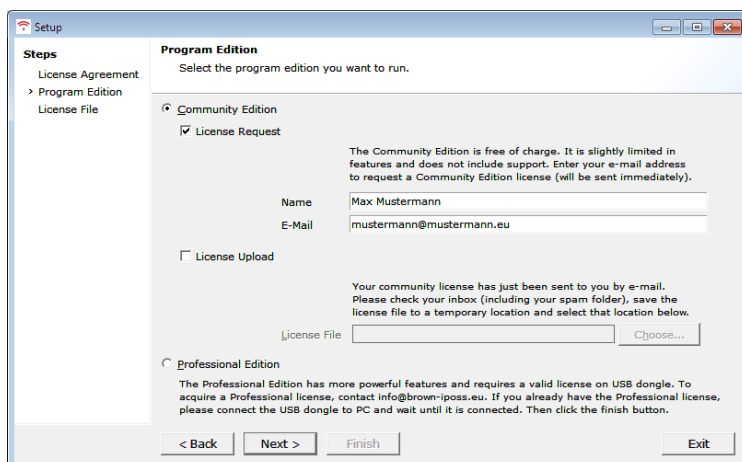


Figure 8: Program edition/License request

After completing the required fields with valid information, an e-mail will be sent to the named e-mail address. This license file is required so it is ought to be downloaded first.

After downloading the file it can be selected by *clicking **Choose** and entering the correct file path*. If this is a valid license file, WiMAP-4G will start for the first time.

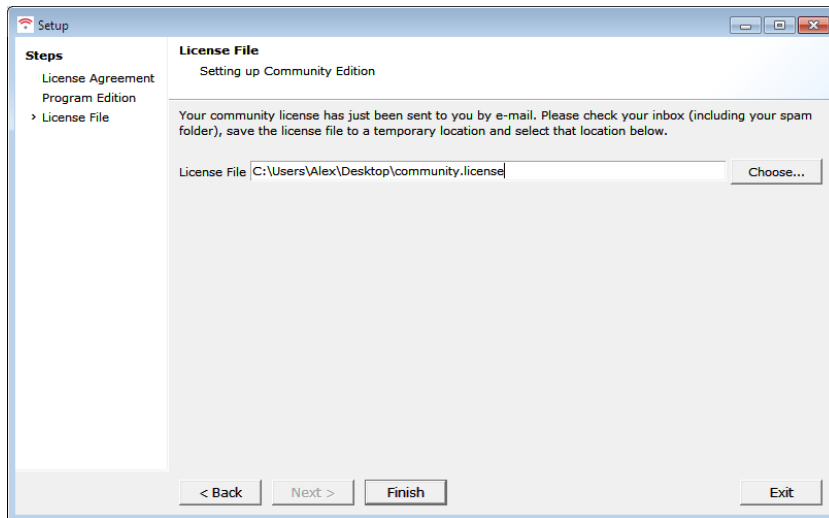


Figure 9: Choose location of your license file

If there are any problems, *try to find a solution in the FAQ* at the end of the user manual first.

1.6 Global Settings

Here you can specify the global settings for WiMAP-4G. These settings effect on the whole program, not only on your individual project. Therefore check chapter 3.1 in this manual.

Go to **Extras** -> **Global Settings**.

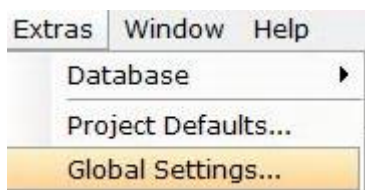


Figure 10: Global Settings

The following settings can be made:

- **Startup**

WiMAP-4G offers you by default a welcome screen where you can select to create a new project, open a previously saved one or use a sample project. In this menu it can be defined how WiMAP-4G shall behave on startup and how many recent projects shall be shown in the list.

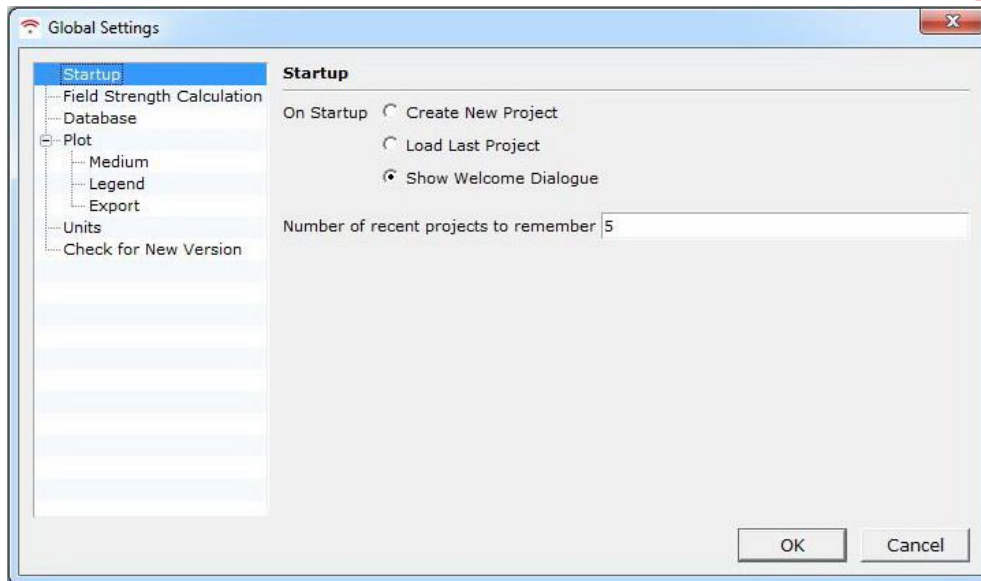


Figure 11: Startup menu

- **Database**

WiMAP-4G uses a default database file for every project, but you can select your own database file instead. In addition you can choose to load **Carriers**, **Antenna Types** and **Point Categories**.

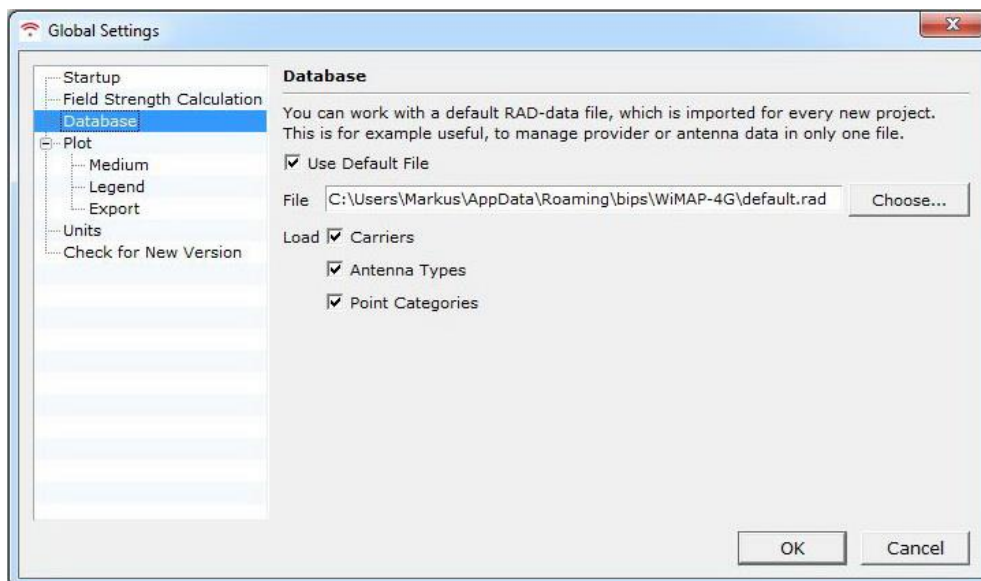


Figure 12: Database menu

- **Plot**

When you *select **Intelligent Label Arrangement*** the label will be arranged so that there is no overlapping of text. You can also specify to draw objects always in black or grey (this overrides the detailed colour settings for antennas or buildings).



For explanation of **Translation Factor** and **Zoom Factor** see chapter 2.3.2.

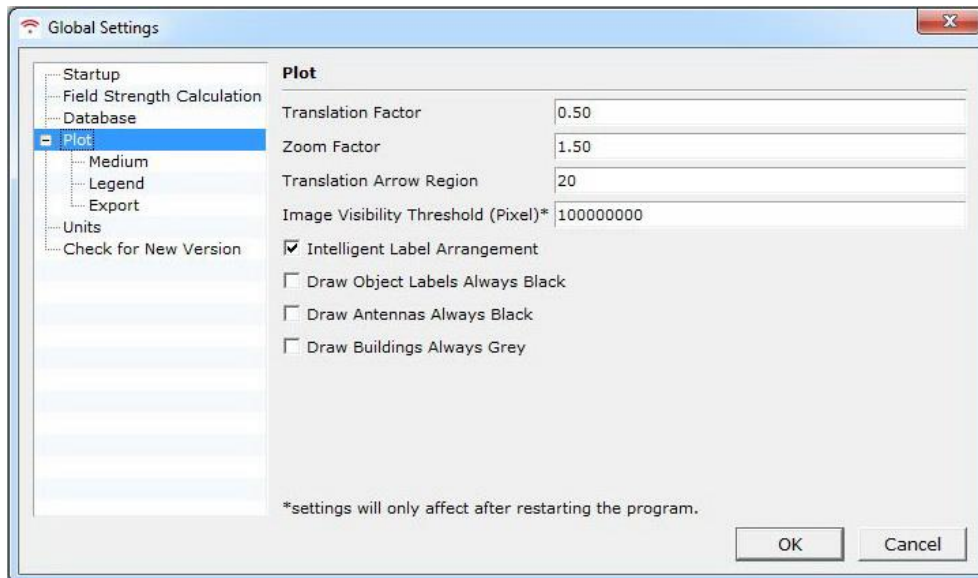


Figure 13: Plot menu

- **Plot -> Export**

Here you can select which information shall be shown when you plot your project.

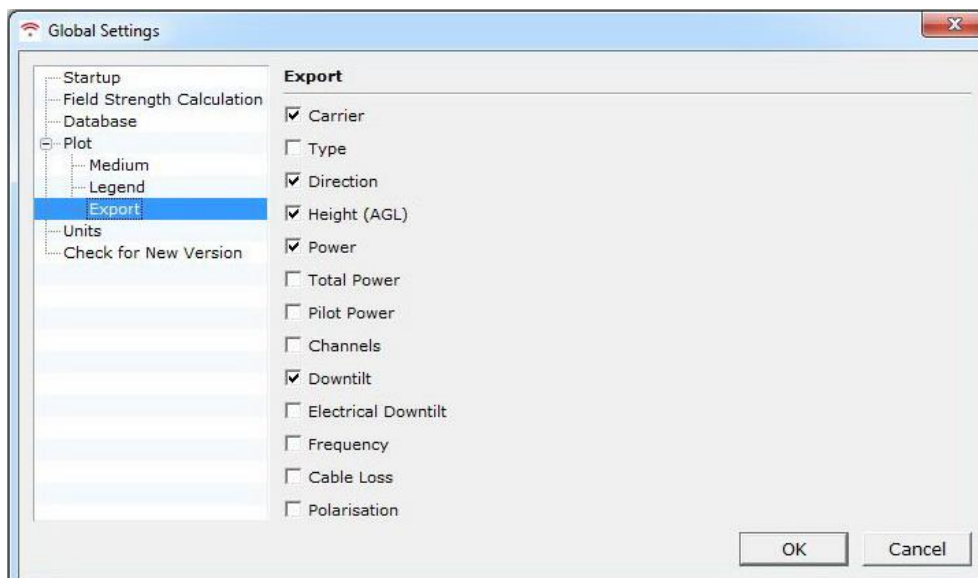


Figure 14: Plot -> Export menu

• Units

The calculation units for **Field Strength**, **Power Level**, **Power Rate** and **Data Rate** can be set here.

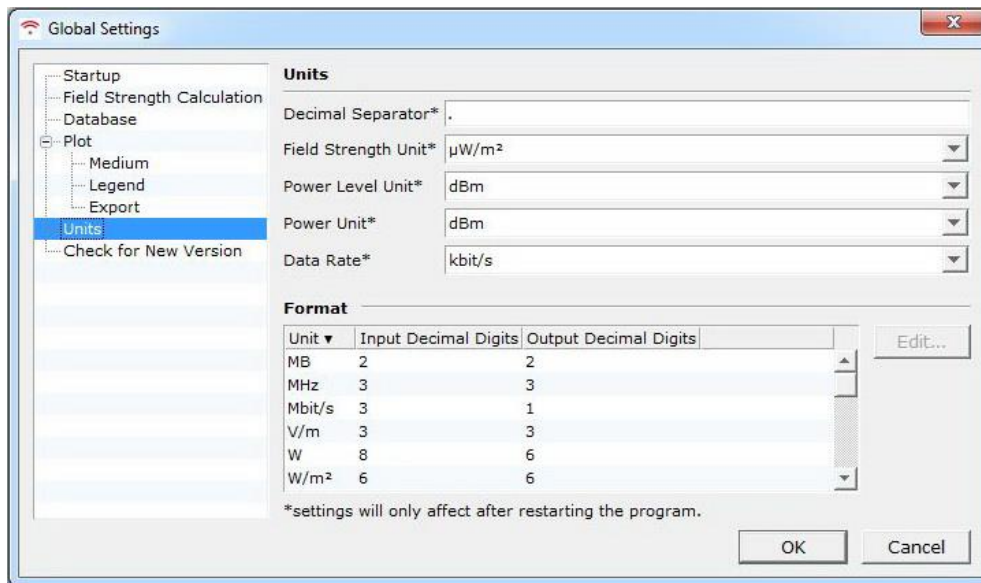


Figure 15: Units menu



These settings will only effect after restarting WiMAP-4G.

• Check for New Version

When starting up WiMAP-4G it will be checked whether a new version is available. Here you can enable to use a proxy server for the internet connection, depending on your system configuration.

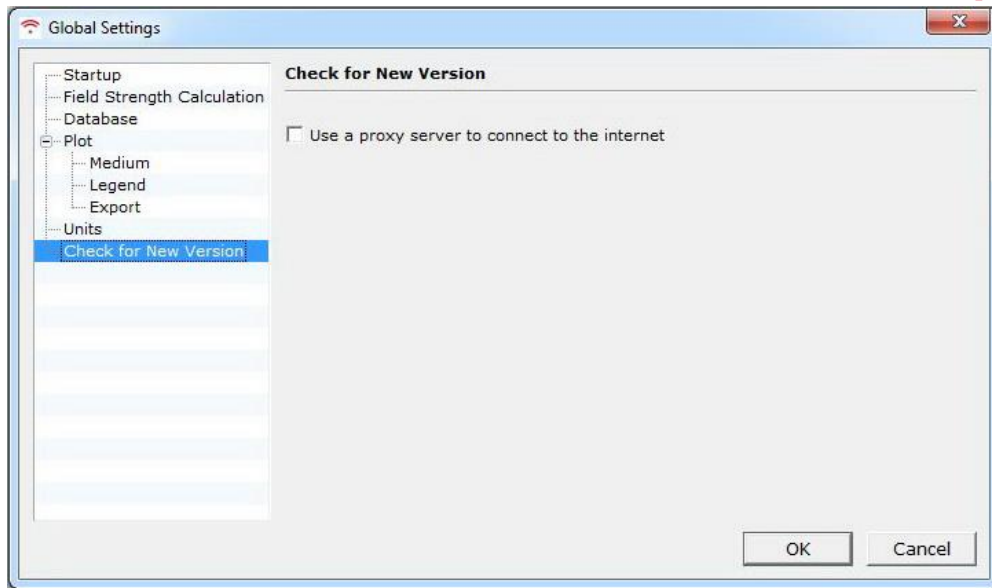


Figure 16: Check for New Version menu

2 First Steps

2.1 The First Project

After installation and activation are successfully completed the program launches and a new project can be created.

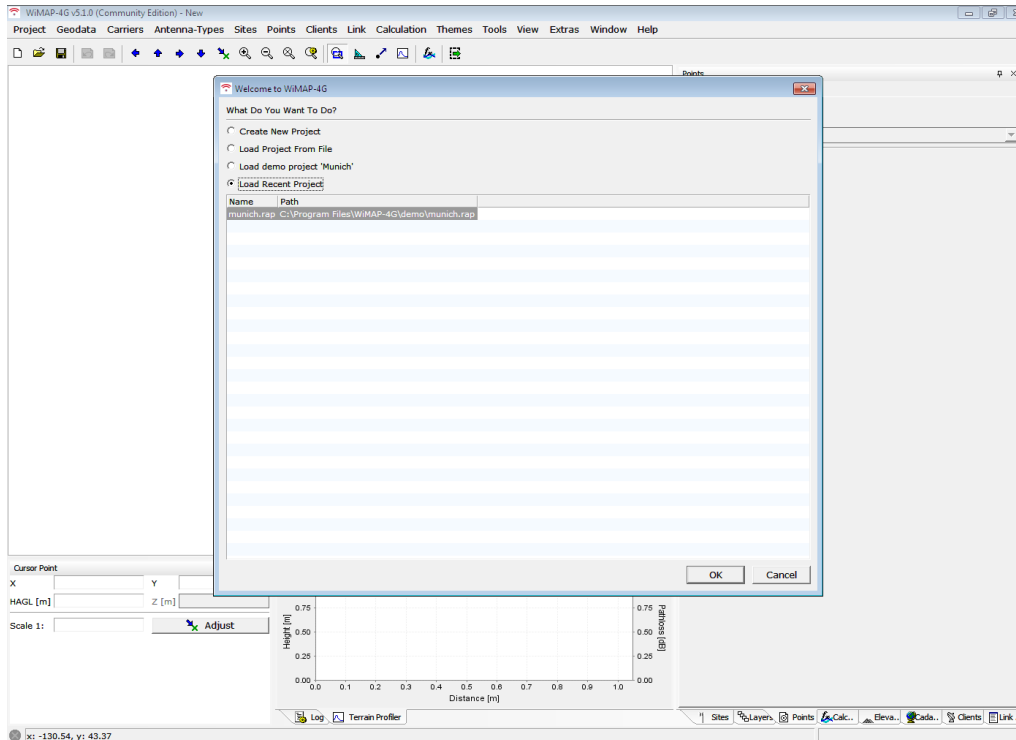


Figure 17: WiMAP-4G launches for the first time

After launching WiMAP-4G for the first time there are three possibilities:

- Create a new project.
- Load a project from a .rad file.
- Have a look at the demo project "Munich".

Newcomers should take a look at the demo project to get an impression of the program and its possibilities.

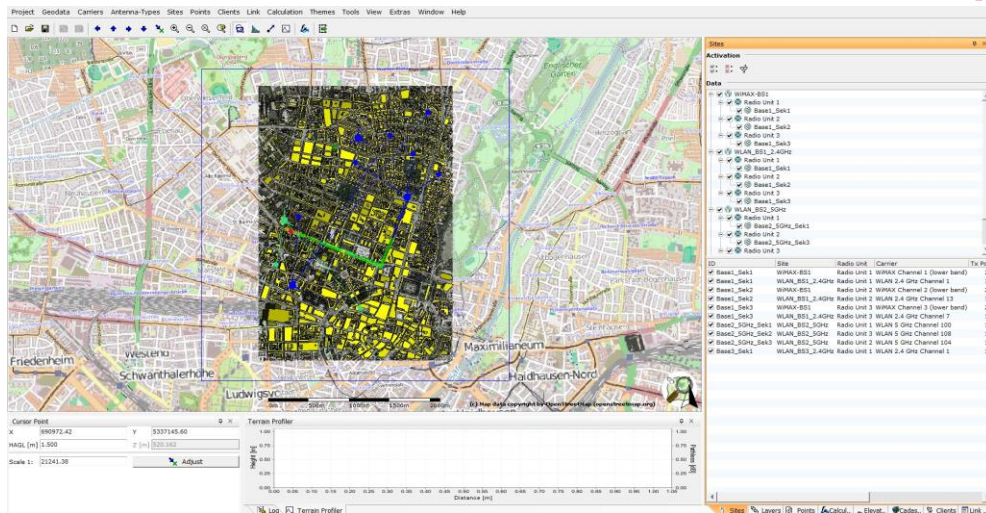


Figure 18: Demo project "Munich"

The demo project is a complete project including sites, different carriers and an elevation model. The Terrain-Profiler can be tested as well as different propagation models.

2.2 Work Area

WiMAP-4G is clearly arranged to make work easier for experienced users and even for newcomers.

2.2.1 Work Area Basics

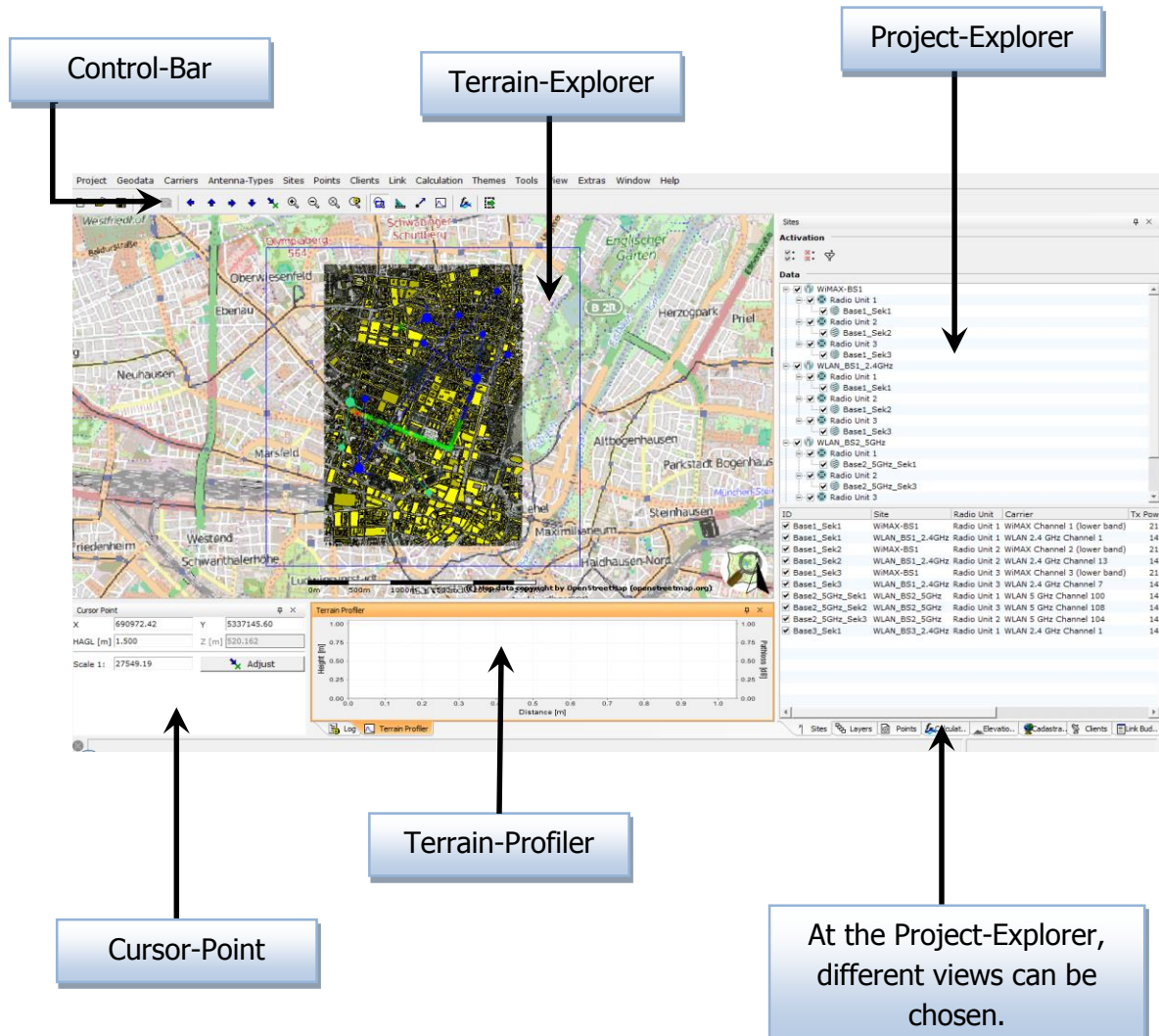


Figure 19: Graphical user interface/work area

Almost all functions can be reached within one or two mouse clicks. The Project-Explorer is on the right side and offers the following views:

- Sites
- Layers
- Points
- Calculation
- Elevation models
- Cadastral data

- Clients
- Link Budget calculation

The view can be changed at every time. At the bottom of the screen the Terrain-Profiler can be found as well as the log and cursor windows. Access the control-bar below the menu bar. The control-bar enables a boundless moving around the terrain, including buttons for all essential functions.

2.2.2 Elements of the Control-Bar



Create a new project. An open project can be saved or discarded.



Load a project from a .rad file. An open project can be saved or discarded.



Save the current project.



One step back. This function affects only changes on the work area. Calculations and object actions cannot be reverted.



One step forward. This function affects only changes on the work area. Calculations and object actions cannot be reverted.



Shift the visible area to west.



Shift the visible area to north.



Shift the visible area to east.



Shift the visible area to south.



Shift the area to center the cursor.



Scale up the visible area. Options can be found at
Extras→Global Settings→Plot



Scale down the visible area. Options can be found at
Extras→Global Settings→Plot



Optimal adjustment of the visible area. Scales up or down and shift to put all objects to the plot.



★ Centers up the selected object. While activated, objects chosen from the Project-Explorer become centered on the screen.



★★

The rectangle-zoom tool.



★★

The distance/measurement tool.



★★

Simply changes object positions with the drag and drop function.



★★

Activates the Terrain-Profiler.



Opens the field strength area calculation. Now the field strength can be calculated with different propagation models.



Export the plot with components to file or to clipboard

★ **This function can be enabled or disabled.**

★★ **Only one of these functions can be enabled at a time.**

Furthermore, any essential function can be found in the submenus. Detailed explanations can be found in the following chapters. The bulk of the screen is filled with the Terrain-Explorer.

As mentioned, there are four functions run by the left mouse button:

- rectangle zoom
- distance/measurement tool
- Terrain-Profiler

- drag and drop function



For shifting the terrain around without using the arrow buttons in the control bar, push and hold the right mouse button.

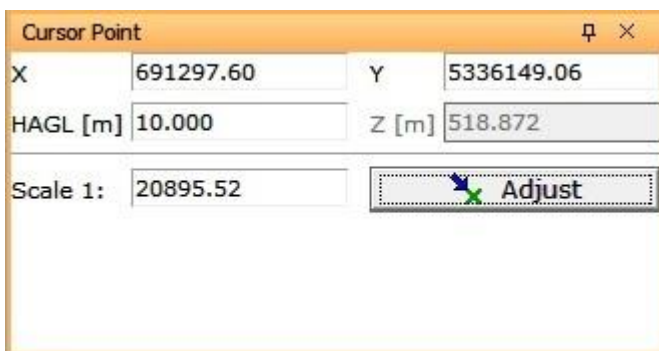
The blue frame inside the Terrain-Explorer shows the maximum area for calculating a propagation model. This blue frame compiles while creating a new project and cannot be changed subsequently.



Originally the propagation models are calculated for the actual image selection. So it is advisable to choose a larger area for this frame than necessary.

The cursor can be set to a specific point by clicking the left mouse button. This can be instrumental in preventing the user from losing track on large projects.

Use the  function to mark a point for easily returning the cursor to at any time or insert coordinates by **Cursor Point** and click on **Adjust** to center the map by this coordinates.



Cursor Point			
X	691297.60	Y	5336149.06
HAGL [m]	10.000	Z [m]	518.872
Scale 1:	20895.52	 Adjust	

Figure 20: Cursor Point

2.2.3 The Rectangle Zoom Tool

The rectangle zoom tool is a useful feature of WiMAP-4G to zoom into the right area on the map.

Just click on the  button on the control bar to activate the rectangle zoom. Choose a point on the map, hold the left mouse button and drag the cursor to mark the exact area.



Figure 21: Rectangle Zoom



Figure 22: Mark an area

The rectangle zoom tool can also be activated by choosing **Tools→Rectangle Zoom**.

2.2.4 The Distance/Measurement Tool

The distance/measurement tool is useful to get a distance or a specific angle of the map.

Click the  button on the control bar to activate the distance/measurement tool. Choose and click on a desired point on the map with the left mouse button, hold the button and drag the cursor to the desired position.

See the distance and angle difference beside the line that connects the start and target point.

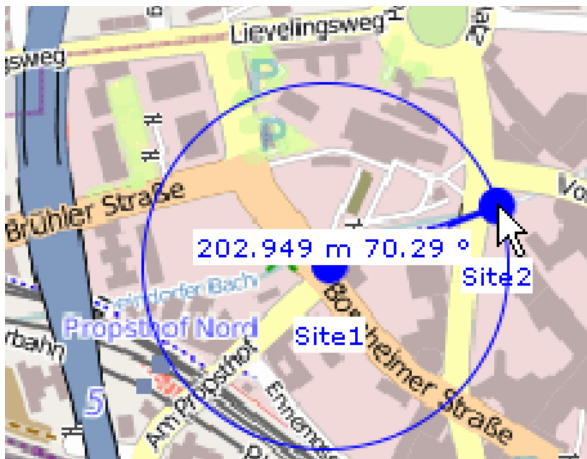


Figure 23: Distance/measurement tool

The distance/measurement tool can also be activated by choosing **Tools→Distance/Angle Measurement**.

2.2.5 The Terrain-Profiler

The Terrain-Profiler is a powerful feature which allows the user to take a snapshot of the environment and watch out for obstacles like mountains or buildings which could interrupt the signal of antennas or disrupt intervisibility. The Terrain-Profiler consists of two parts, the tool itself that can be used to drag around the map and watch out for obstacles and the Terrain-Profiler tab which shows the territory inside the dragged zone. The Terrain-Profiler basically works similar to the distance measurement tool, except the additional tab that shows the territory.

2.2.5.1 How to Use the Terrain-Profiler

1. Click on the  button on the control bar to activate the Terrain-Profiler tool. Click on a desired point on the map, hold the left mouse button and drag the cursor to the desired position.

See the distance and angle difference beside the line that connects the start and target point.

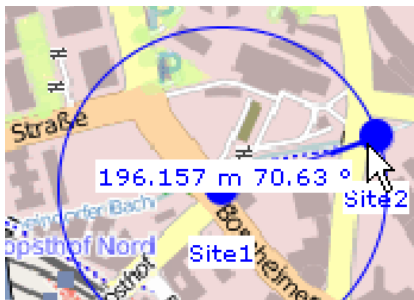


Figure 24: The Terrain-Profiler looks like the distance/measurement tool.

2. For additional information look in the Terrain-Profiler tab which is at the bottom of the WiMAP-4G window by default. The graph in Figure 25 shows how the Terrain-Profiler projects the territory into the Terrain-Profiler tab.

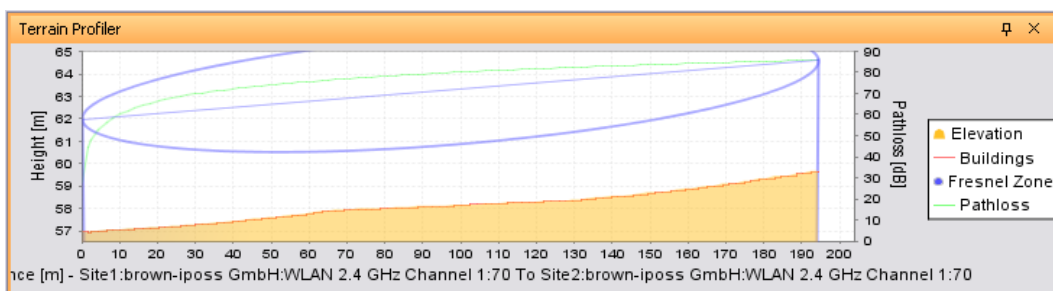


Figure 25: The Terrain-Profiler tab

On the right side of the Terrain-Profiler tab is a legend that shows all relevant information: elevation, buildings, the Fresnel Zone and the pathloss. The circle will automatically change its colour to red if there is any disruption in the Fresnel Zone.

This will help the user to see automatically if the desired path is possible or not.

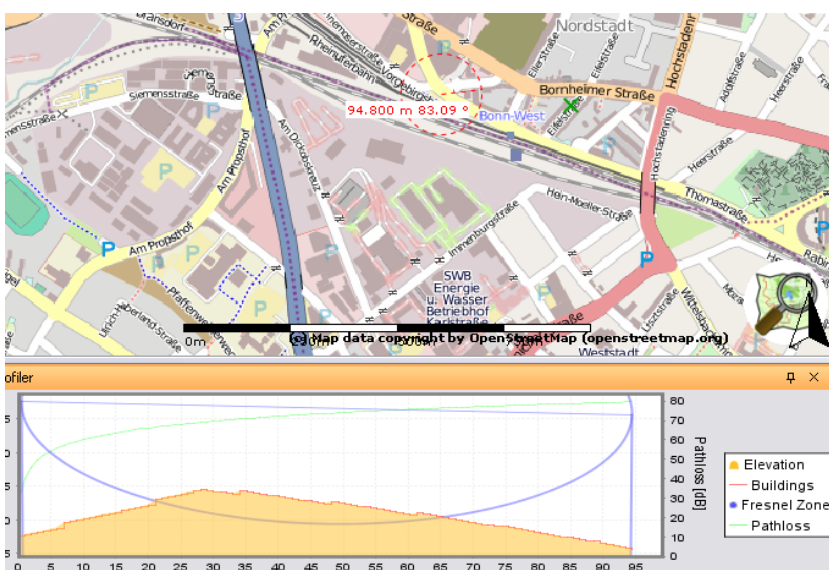


Figure 26: The Fresnel Zone is interrupted.

2.2.5.2 Configuring the Terrain-Profiler

The Terrain-Profiler offers a few settings which can be changed to get a better overview and to make the result descriptive for presentations.

*Click on the right mouse button to open a menu that contains the function **Properties**. A click on that button will open the property configuration window.*

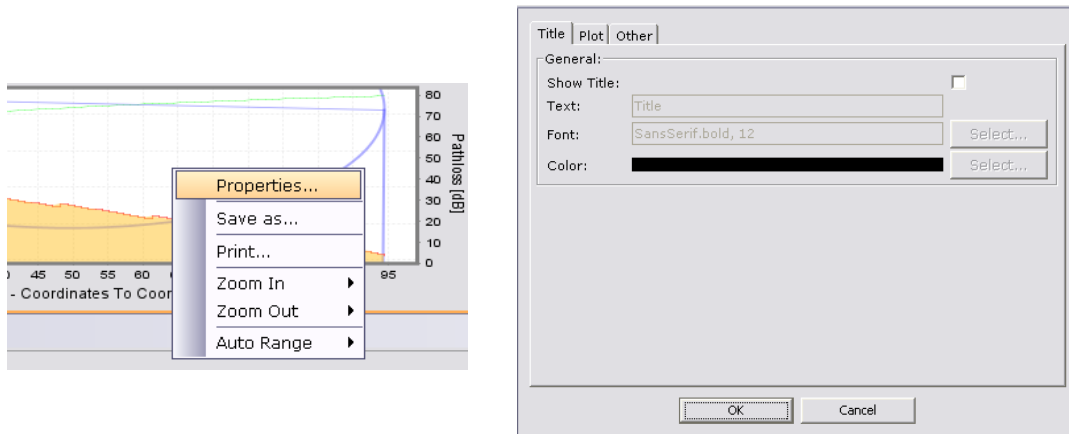


Figure 27: The Terrain-Profiler configuration menu

A figure can be named in the title tab. This could be useful for presentation or further information if the results of the Terrain-Profiler are exported. **Activate** shows the title.

*Enter the desired title in the **Text** field. To choose a font, click on **Select** next to the font field and choose the desired text font, the text size and a format. Click on **OK** to save the alterations.*

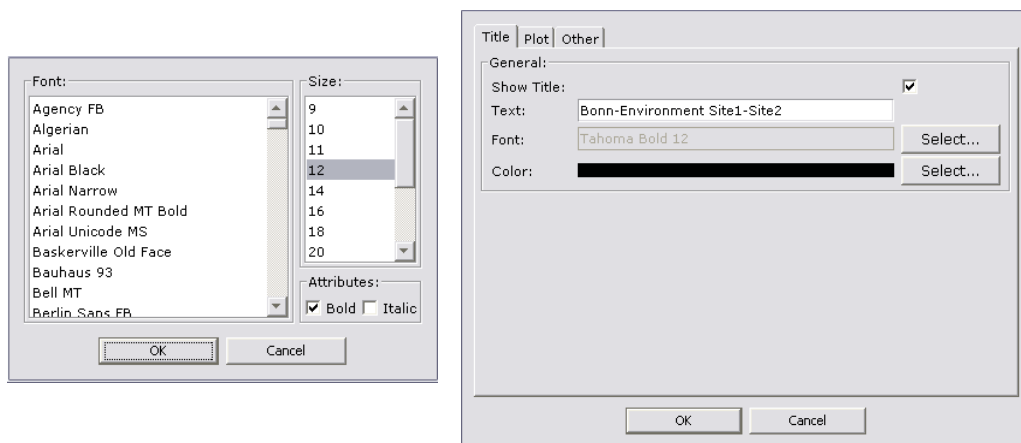


Figure 28: Change title, font and colour

*Click on **Plot** tab to make some additional configurations.*

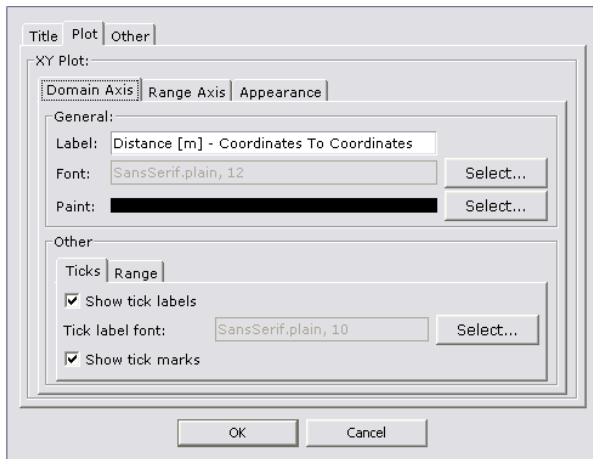


Figure 29: The plot menu

The **Plot** tab contains all settings according to the axes.

*Change the label text by editing the **label** field. Font and text colour can also be changed within the tab.*

There are some additional settings provided at the bottom of the window. **Tick labels** can be *enabled or disabled*.

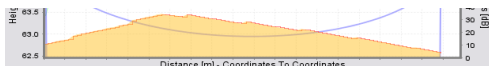


Figure 30: Disabled tick labels

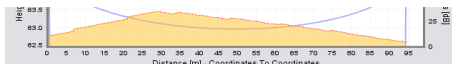


Figure 31: Enabled tick labels

Tick label marks can also be *enabled or disabled*.

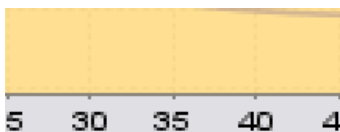


Figure 32: Enabled tick marks

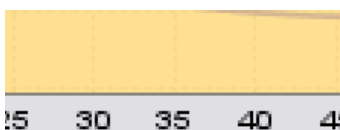


Figure 33: Disabled tick marks

In the **range tab** at the bottom of the window, *the range value can be modified*. If there are no specific circumstances, **auto adjust range** should be activated.

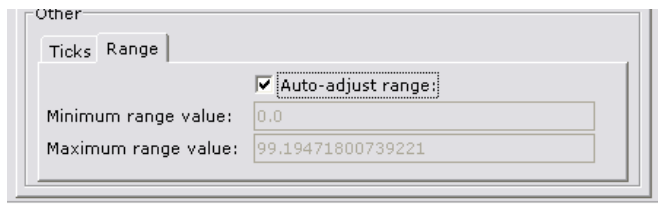


Figure 34: The range tab

All these settings also work for the range axis. At last, there is the **appearance tab** which contains settings to change the layout of the Terrain-Profiler.

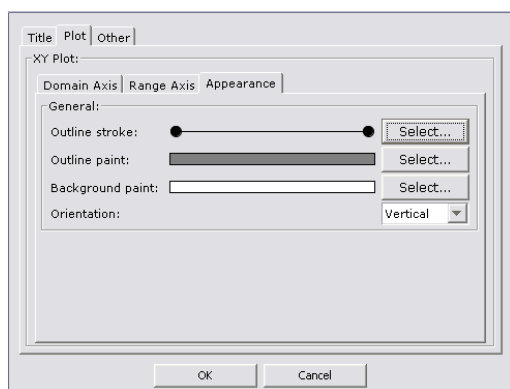


Figure 35: The appearance tab

The **outline stroke** defines the thickness of the outline.

*For changing the colour of the outline click on the **Select** button next to the **Outline paint** row and choose a desired colour.*

The background paint defines the background colour of the plot itself. Preferably pick a neutral colour like white in order to not interfere the overview. The orientation of the plot can also be changed to vertical or horizontal. The **other** tab offers the following additional settings:

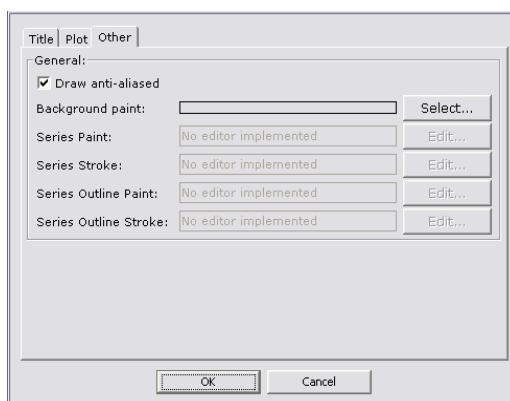


Figure 36: The other tab

Anti-aliasing can be activated or deactivated. If there are no specific circumstances, anti-aliasing should always be enabled.

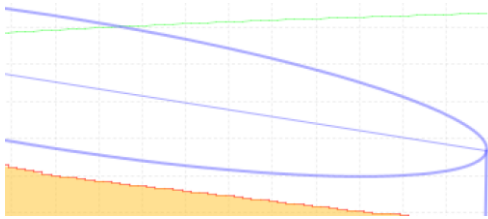


Figure 37: Anti-aliasing enabled

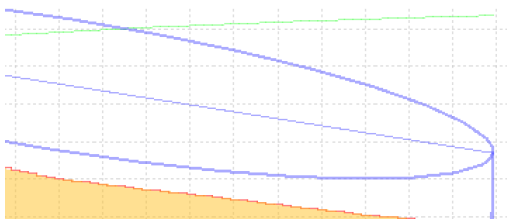


Figure 38: Anti-aliasing disabled

The **background paint** defines the colour of the Terrain-Profiler, not the colour of the plot.

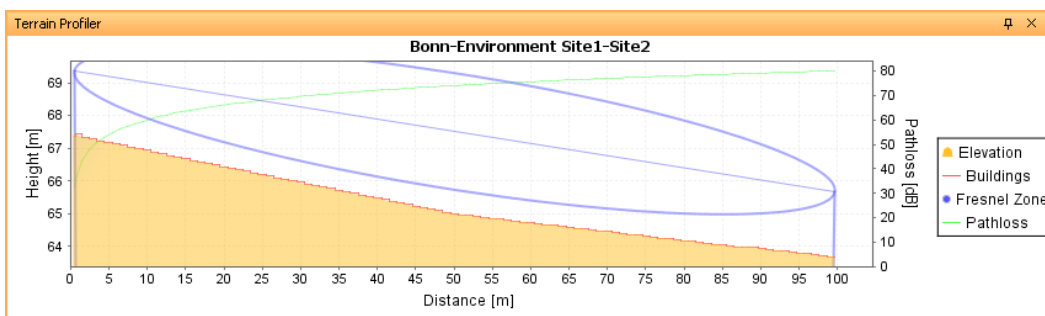


Figure 39: A configured Terrain-Profiler tab

2.2.5.3 Additional Terrain-Profiler Zoom

The Terrain-Profiler offers some additional functions for better analysis. Both axes can be zoomed in/out independently. A *right mouse click* on the **Terrain-Profiler tab** opens the menu that contains all zoom functions.

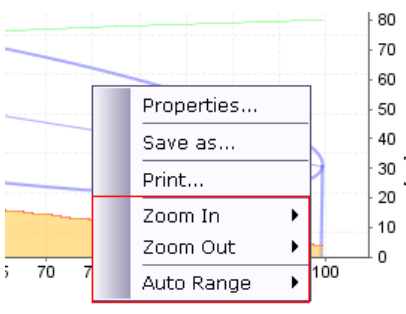


Figure 40: Terrain-Profiler zoom functions

Each zoom submenu contains these three possibilities:

- **both axes:** zooms in/out the full image considering the x/y-ratio
- **domain axis:** zooms in/out the y-axis
- **range axis:** zooms in/out the x-axis

The **auto range submenu** assures that all content of the marked terrain segment is shown.

2.2.5.4 Terrain-Profiler Export Features

Export functions are available for the Terrain-Profiler, too. Results can be printed or exported for other applications or presentations. A *right mouse click* on the **Terrain-Profiler** tab opens the menu window containing the possibilities to **Print** or **Save** the Terrain-Profiler results:

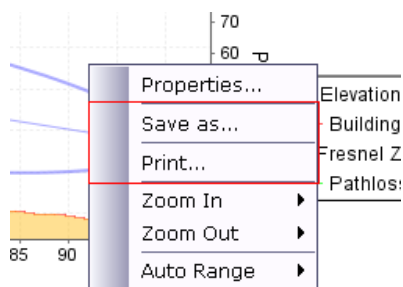


Figure 41: A plot can be saved or printed.

By clicking on **Print**, the printer window opens:

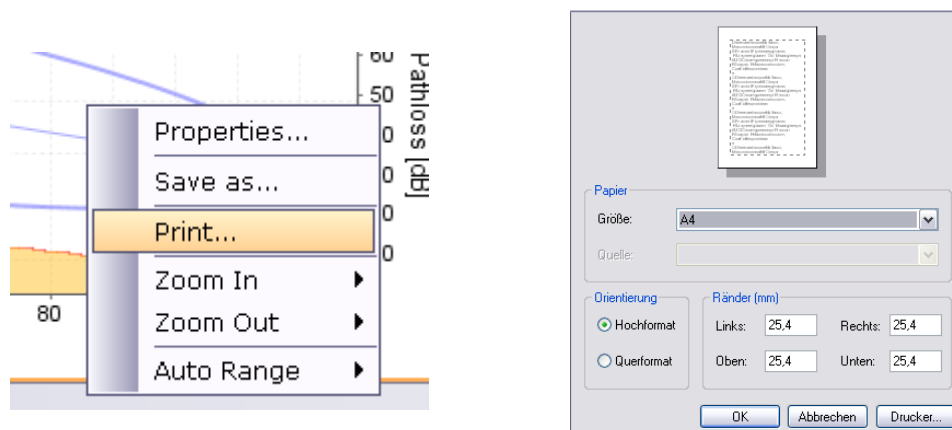


Figure 42: The printer window

Depending on the installed Java version, the window can have different looks, but settings are the same.

After choosing the desired settings, a click on **OK** opens the printer menu.

Printing can be started. Another way to export the Terrain-Profiler results is the **Save as** option which allows the user to store the plot as an image file on his hard drive.

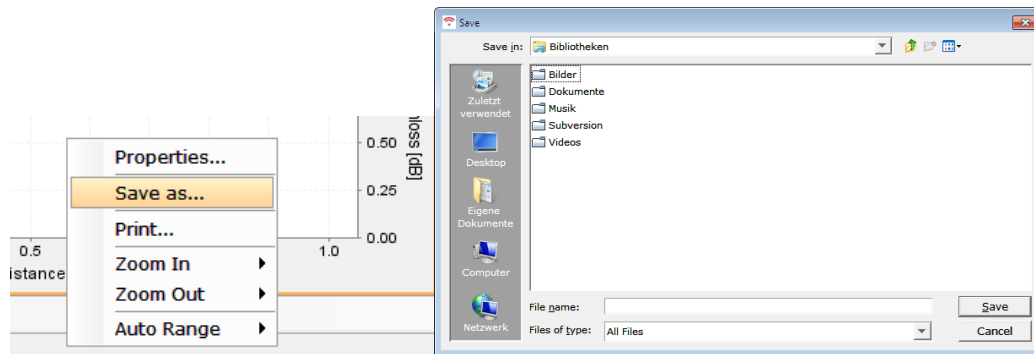


Figure 43: The plot can be saved as a .png-file.

After choosing the file path and file name, click on **Save** to store the Terrain-Profiler results in a .png file.

2.3 Customizing the Work Area

There are settings in WiMAP-4G that make work easier. These settings will be explained in this section. Generally WiMAP-4G is designed for working on a large screen. If that is not the case or the user works on a screen with a low resolution, it is necessary to customize the program.

2.3.1 Transfix the Windows

The Project-Explorer, the Terrain-Profiler and also the log and cursor window can be transfixed by *clicking on* . When windows are transfixed, they only expand getting focused by the mouse cursor. This option can be reverted by only one *mouse click on*  or *choosing **Window→Reset Layout*** to reset all windows. The window size can also be changed by simply *holding the left mouse button on a border of a window to drag it to the desired size*.

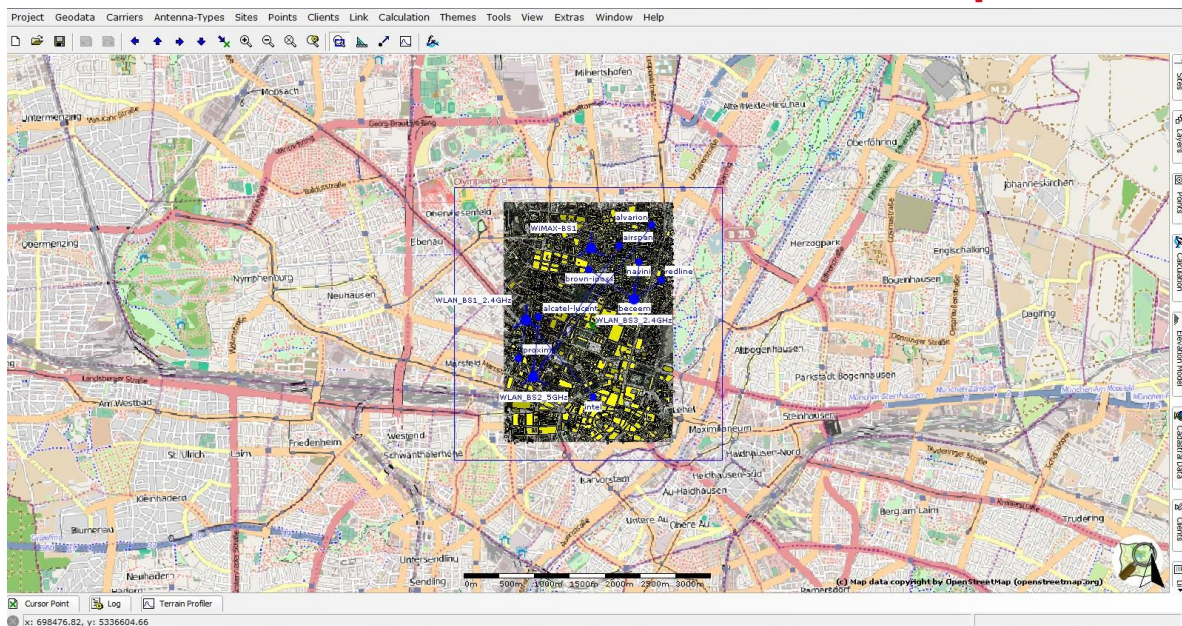


Figure 44: Transfixing the windows results in a much bigger work area

2.3.2 Adjustment and Zoom Customization

More settings can be found in **Extras→Global Settings**. The following settings can be set up in the submenu **Plot**.

Translation factor: This setting is essential for the four arrows in the control bar. The translation factor gives information about how far the map is shifted by using these arrow-buttons.

A 1 means the whole map is shifted by an entire size of the screen.

A 0.1 means the map is shifted by 10 % of the size of the screen.

Boundary: 0.1 – 10

Zoom factor: The zoom factor option is important for the two zoom button in the control bar. It shows how much the map is up- or downscaled.

A 1 simply means that the map is zoomed in by factor one, so nothing will happen with a 1. Values between 0.1 and 0.9 invert the zoom functions so that the scale up button scales down for example.

With a 1.1 the entire map scales up or down by 10 %.

Boundary: 0.1 - 10

Below, the labels can be configured to show objects and/or antennas coloured black and buildings gray. There is also an option for the intelligent label arrangement which gives the program the privilege to ignore the label standards if necessary.

The size of pixel and labels can be changed in the submenu medium. Label size can be changed between 0.5 and 30 mm variably. The pixel size should only be changed if presentation errors occur.

It is possible to change position and visibility of the legend in the submenu **Legend**.

2.4 The Project-Explorer

The **Project-Explorer** combines every object used in the actual project for a quite good overview. Each created, edited or imported case can be found in the Project-Explorer for detailed actions.

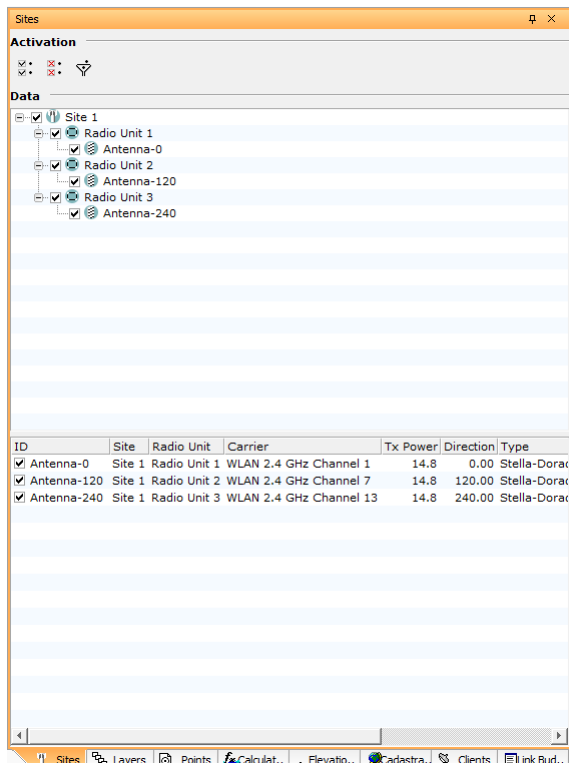


Figure 45: The Project-Explorer

The following tabs can be found in the **Project-Explorer**:

- Sites
- Layers
- Points
- Calculation
- Elevation model
- Cadastral data
- Clients
- Link budget calculation

Every tab is designed individually to offer a good orientation and to keep all actions as simple as possible.

2.4.1 The Sites Tab

The **Sites tab** in the **Project-Explorer** gives an overview of all sites, radio units and antennas used in the project.

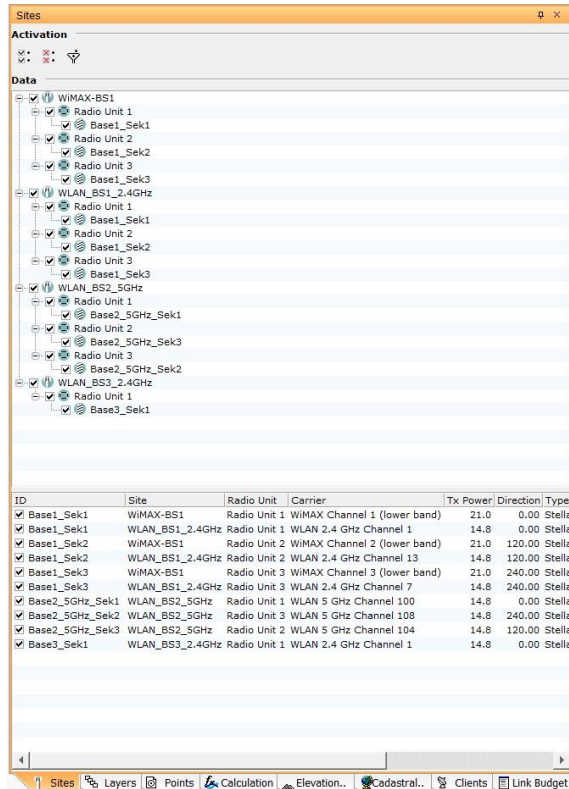


Figure 46: The Sites tab

The upper part of the **Sites tab** shows all sites used in the project.

If you right click on one element in the upper part site, radio unit or antenna offers a few options for creation, deletion, activation, change multiple etc. More information can be found in the corresponding chapter in this manual.

The lower part of the **Sites tab** shows all the antennas used in the project with their corresponding sites, radio unit and used carriers. If a site, radio unit or antenna is chosen in the upper part, the matching antenna(s) in the lower part are marked.

Sites and antennas can be activated or deactivated just by *checking or unchecking the boxes beside the desired antenna, radio unit or site*. A deactivated antenna does not appear neither in a calculation nor on the map.

2.4.2 The Layers Tab

The important thing to understand while working with WiMAP-4G: All things managed by the program are organized in layers and can be deactivated or activated as desired. Layers will

be created in WiMAP-4G for every single case created or edited by program: buildings, calculations, elevation, sites, clients, points etc.

In the **Project-Explorer** of the **Layers tab**, all layers are listed.

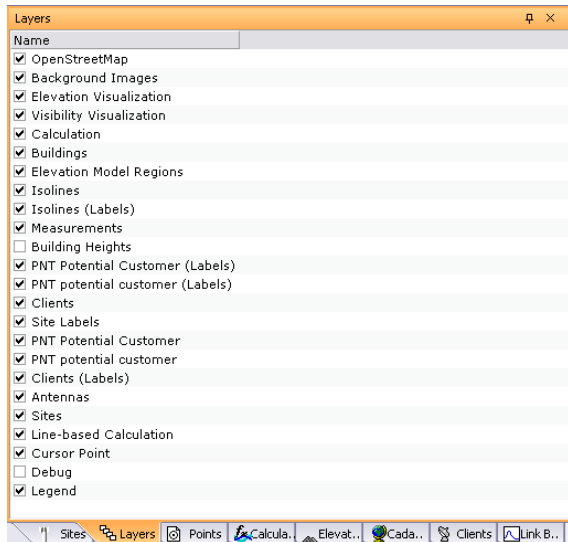


Figure 47: The Layers tab

In Figure 47 you can see the **Layers tab** in the **Project-Explorer**, where everything is activated except debug and building heights.

To deactivate a layer simply uncheck the box next to the layer name. Layers will be created automatically while performing actions such as calculations or building creation. The layers given in this example are the standard layers preconfigured for every project. Not all of them are used while creating a new project.

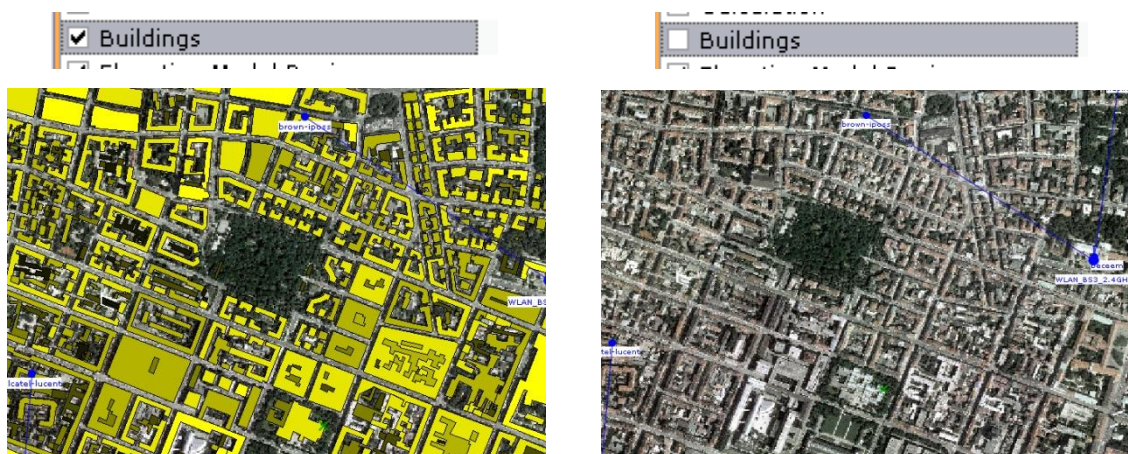
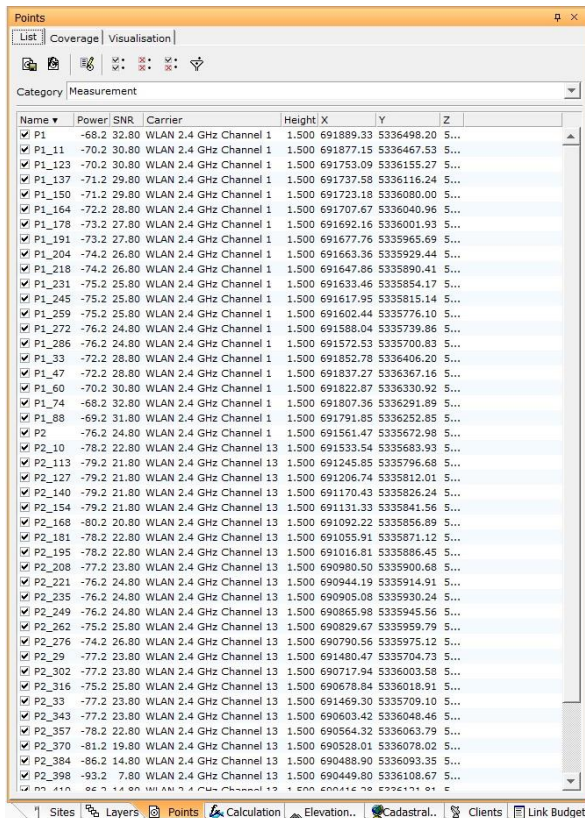


Figure 48: Buildings layer enabled and disabled

2.4.3 The Points Tab

The **Points tab** has three subtabs: **List**, **Coverage** and **Visualisation**. The **List tab** shows all points used in the project sorted by the point category. Points can be activated or deactivated. If the used points are not listed in the **Points tab**, make sure to choose the correct point category.



Name	Power	SNR	Carrier	Height	X	Y	Z
✓ P1	-68.2	32.80	WLAN 2.4 GHz Channel 1	1.500	691889.33	5336498.20	5...
✓ P1_11	-70.2	30.80	WLAN 2.4 GHz Channel 1	1.500	691877.15	5336467.53	5...
✓ P1_123	-70.2	30.80	WLAN 2.4 GHz Channel 1	1.500	691753.09	5336155.27	5...
✓ P1_137	-71.2	29.80	WLAN 2.4 GHz Channel 1	1.500	691737.58	5336116.24	5...
✓ P1_150	-71.2	29.80	WLAN 2.4 GHz Channel 1	1.500	691723.18	5336080.00	5...
✓ P1_164	-72.2	28.80	WLAN 2.4 GHz Channel 1	1.500	691707.67	5336040.96	5...
✓ P1_178	-73.2	27.80	WLAN 2.4 GHz Channel 1	1.500	691692.16	5336001.93	5...
✓ P1_191	-73.2	27.80	WLAN 2.4 GHz Channel 1	1.500	691677.76	5335965.69	5...
✓ P1_204	-74.2	26.80	WLAN 2.4 GHz Channel 1	1.500	691663.36	5335929.44	5...
✓ P1_218	-74.2	26.80	WLAN 2.4 GHz Channel 1	1.500	691647.86	5335890.41	5...
✓ P1_231	-75.2	25.80	WLAN 2.4 GHz Channel 1	1.500	691633.46	5335854.17	5...
✓ P1_245	-75.2	25.80	WLAN 2.4 GHz Channel 1	1.500	691617.95	5335815.14	5...
✓ P1_259	-75.2	25.80	WLAN 2.4 GHz Channel 1	1.500	691602.44	5335776.10	5...
✓ P1_272	-76.2	24.80	WLAN 2.4 GHz Channel 1	1.500	691588.04	5335739.86	5...
✓ P1_286	-76.2	24.80	WLAN 2.4 GHz Channel 1	1.500	691572.53	5335700.83	5...
✓ P1_33	-72.2	28.80	WLAN 2.4 GHz Channel 1	1.500	691852.78	5336406.20	5...
✓ P1_47	-72.2	28.80	WLAN 2.4 GHz Channel 1	1.500	691837.27	5336367.16	5...
✓ P1_60	-70.2	30.80	WLAN 2.4 GHz Channel 1	1.500	691822.87	5336330.92	5...
✓ P1_74	-68.2	32.80	WLAN 2.4 GHz Channel 1	1.500	691807.36	5336291.89	5...
✓ P1_88	-69.2	31.80	WLAN 2.4 GHz Channel 1	1.500	691791.85	5336252.85	5...
✓ P2	-76.2	24.80	WLAN 2.4 GHz Channel 1	1.500	691561.47	5335672.98	5...
✓ P2_10	-78.2	22.80	WLAN 2.4 GHz Channel 13	1.500	691533.54	5335683.93	5...
✓ P2_113	-79.2	21.80	WLAN 2.4 GHz Channel 13	1.500	691245.85	5335796.68	5...
✓ P2_127	-79.2	21.80	WLAN 2.4 GHz Channel 13	1.500	691206.74	5335812.01	5...
✓ P2_140	-79.2	21.80	WLAN 2.4 GHz Channel 13	1.500	691170.43	5335826.24	5...
✓ P2_154	-79.2	21.80	WLAN 2.4 GHz Channel 13	1.500	691131.33	5335841.56	5...
✓ P2_168	-80.2	20.80	WLAN 2.4 GHz Channel 13	1.500	691092.22	5335856.89	5...
✓ P2_181	-78.2	22.80	WLAN 2.4 GHz Channel 13	1.500	691055.91	5335871.12	5...
✓ P2_195	-78.2	22.80	WLAN 2.4 GHz Channel 13	1.500	691016.81	5335886.45	5...
✓ P2_208	-77.2	23.80	WLAN 2.4 GHz Channel 13	1.500	690980.50	5335900.68	5...
✓ P2_221	-76.2	24.80	WLAN 2.4 GHz Channel 13	1.500	690944.19	5335914.91	5...
✓ P2_235	-76.2	24.80	WLAN 2.4 GHz Channel 13	1.500	690905.08	5335930.24	5...
✓ P2_249	-76.2	24.80	WLAN 2.4 GHz Channel 13	1.500	690865.98	5335945.56	5...
✓ P2_262	-75.2	25.80	WLAN 2.4 GHz Channel 13	1.500	690829.67	5335959.79	5...
✓ P2_276	-74.2	26.80	WLAN 2.4 GHz Channel 13	1.500	690790.56	5335975.12	5...
✓ P2_29	-77.2	23.80	WLAN 2.4 GHz Channel 13	1.500	691480.47	5335704.73	5...
✓ P2_302	-77.2	23.80	WLAN 2.4 GHz Channel 13	1.500	690717.94	5336003.58	5...
✓ P2_316	-75.2	25.80	WLAN 2.4 GHz Channel 13	1.500	690678.84	5336018.91	5...
✓ P2_33	-77.2	23.80	WLAN 2.4 GHz Channel 13	1.500	691469.30	5335709.10	5...
✓ P2_343	-77.2	23.80	WLAN 2.4 GHz Channel 13	1.500	690603.42	5336048.46	5...
✓ P2_357	-78.2	22.80	WLAN 2.4 GHz Channel 13	1.500	690564.32	5336063.79	5...
✓ P2_370	-81.2	19.80	WLAN 2.4 GHz Channel 13	1.500	690528.01	5336078.02	5...
✓ P2_384	-86.2	14.80	WLAN 2.4 GHz Channel 13	1.500	690488.90	5336093.35	5...
✓ P2_398	-93.2	7.80	WLAN 2.4 GHz Channel 13	1.500	690449.80	5336108.67	5...
✓ P2_410	-66.2	34.80	WLAN 2.4 GHz Channel 13	1.500	690416.78	5336121.81	5...

Figure 49: All used points will be shown in a list.

A right click on a point offers the possibilities to create, edit, or delete a point. The little icons in the right upper corner allow export and calculation of the points and gives the possibility to edit the point classes. More information can be found in the corresponding chapter in this manual.

The **Coverage tab** is for showing the colour of coverage levels based on the colour diagram of the carrier.

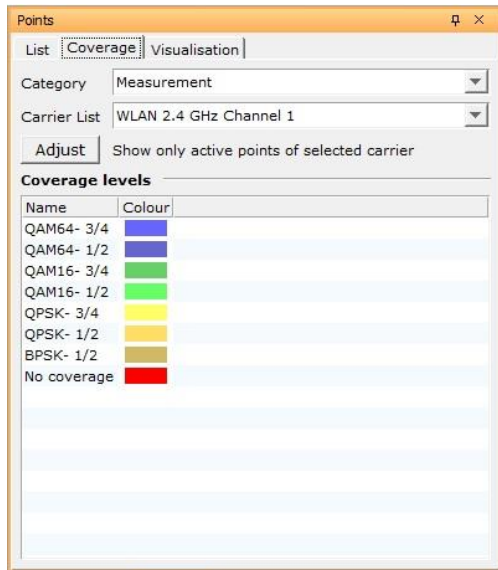


Figure 50: The Points tab – Coverage

The **Visualisation tab** is for colouring points based on the *category*, the *parameter* that is visualised and the *colouring* which are shown in a table by *Intervals*. With one click on *Adjust* the colour is set. With *Reset* colour settings are restored back to the latter colouring.

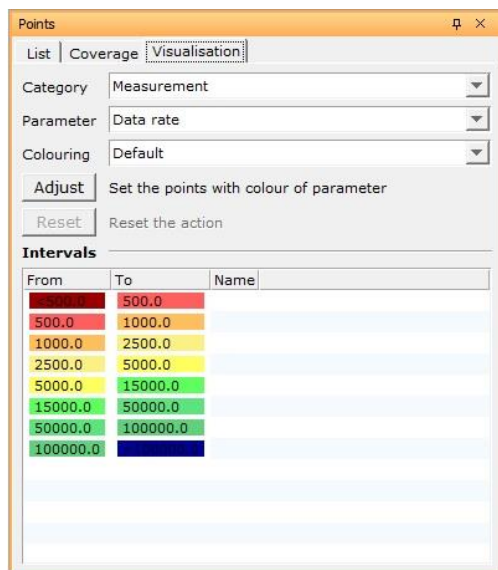


Figure 51: The Points tab – Visualisation

2.4.4 The Calculation Tab

The **Calculation tab** is one of the most important tabs and shows all done calculation in the actual project.

If a calculation is done, all sites and antennas used in this calculation will be shown in the **Calculation tab**. Single sites or antennas can be activated or deactivated for getting better

calculation results or even finding an interfering one. The upper part of the calculation tab offers all important calculations that are possible with WiMAP-4G.

Right click on sites, radio unit or antennas offers many features described in corresponding chapters of this manual.

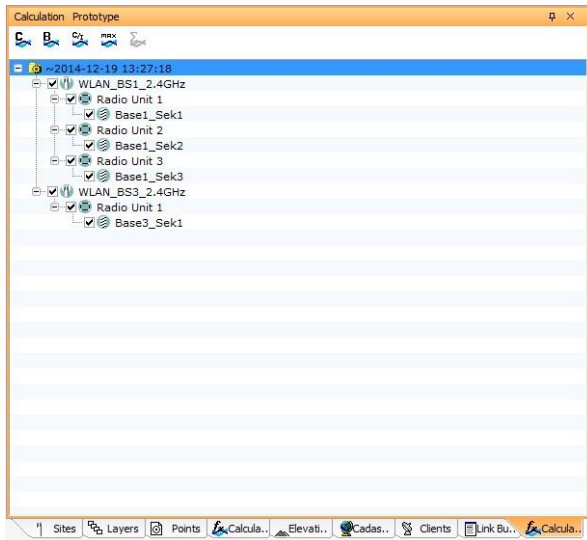


Figure 52: The Calculation tab

2.4.5 The Elevation Model Tab

The **Elevation Model tab** shows all elevation data that is used in the actual project. The elevation model file name and the file path are shown.

A right click on an elevation model file offers the possibility to unload the file. More information about elevation models, elevation model import and editing elevation models can be found in the corresponding chapters of this manual.

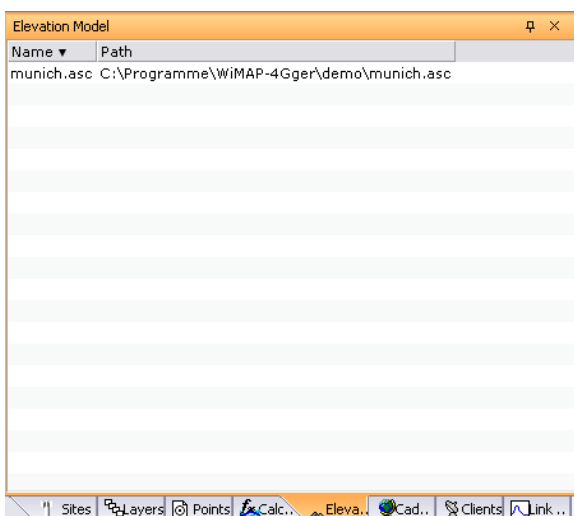


Figure 53: The Elevation Model tab

2.4.6 The Cadastral Data Tab

The **Cadastral Data tab** shows all the cadastral data which is used in the actual project. The cadastral data file name and the file path are shown.

A right click on a cadastral data file offers the possibility to unload this file. More information about cadastral data and cadastral data import can be found in the corresponding chapters of this manual.

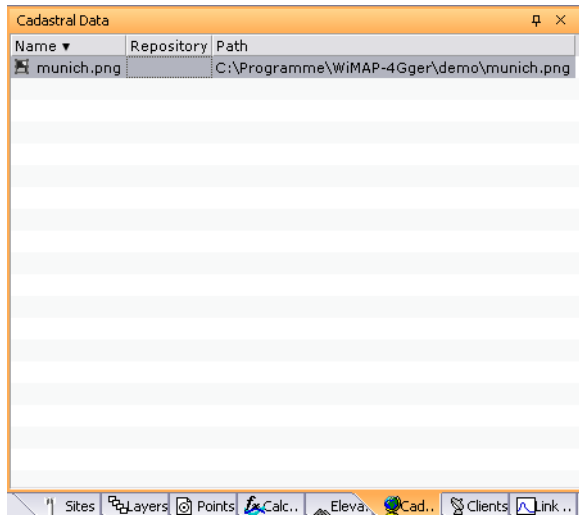


Figure 54: The Cadastral Data tab

2.4.7 The Clients Tab

The **Clients tab** shows all created clients in the actual project with their corresponding profile, height, coverage, power level, and carrier to interfere values.

A right click on a client offers all the possibilities to create, edit or delete the client and to choose the Terrain-Explorer to show the environment between the client and his corresponding site. More information about clients and associated possible actions can be found in the corresponding chapters of this manual.

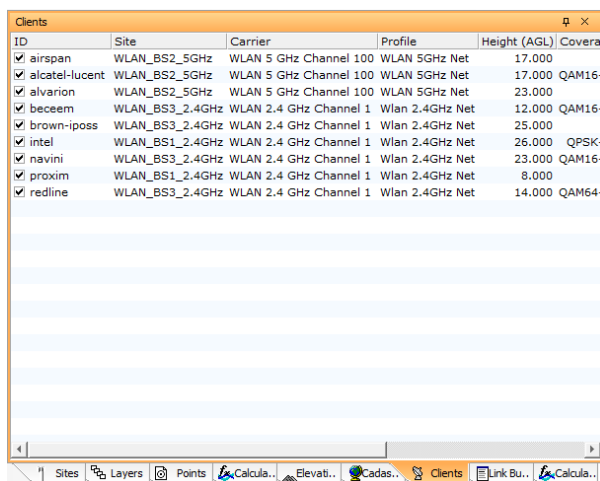
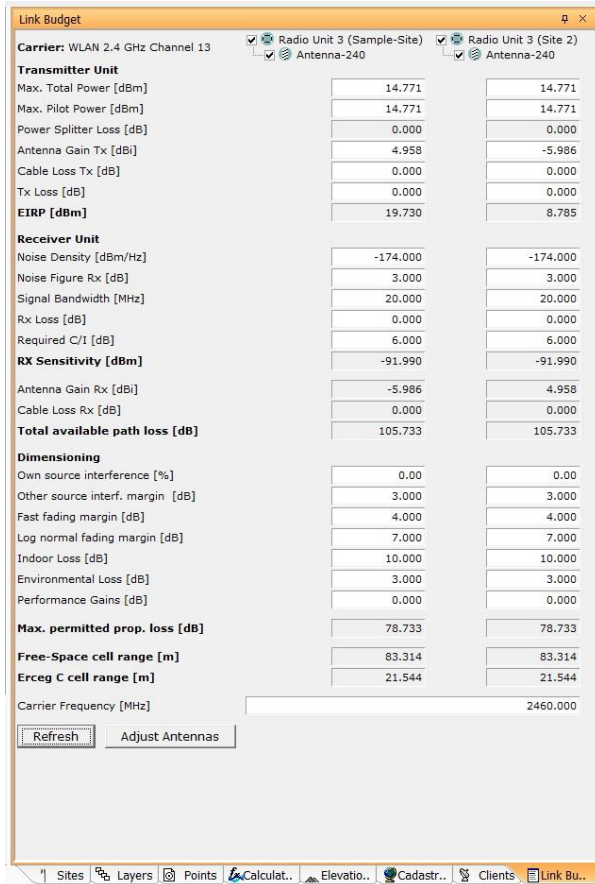


Figure 55: The Clients tab

2.4.8 The Link Budget Tab

The **Link Budget tab** offers the user the possibility to calculate a detailed link budget for a desired situation.

Many variables can be inserted to guarantee the most precise results. The **Link Budget tab** will be explained later in this manual so take a look on the corresponding chapters.



	Radio Unit 3 (Sample-Site)	Radio Unit 3 (Site 2)
Carrier: WLAN 2.4 GHz Channel 13		
Transmitter Unit		
Max. Total Power [dBm]	14.771	14.771
Max. Pilot Power [dBm]	14.771	14.771
Power Splitter Loss [dB]	0.000	0.000
Antenna Gain Tx [dBi]	4.958	-5.986
Cable Loss Tx [dB]	0.000	0.000
Tx Loss [dB]	0.000	0.000
EIRP [dBm]	19.730	8.785
Receiver Unit		
Noise Density [dBm/Hz]	-174.000	-174.000
Noise Figure Rx [dB]	3.000	3.000
Signal Bandwidth [MHz]	20.000	20.000
Rx Loss [dB]	0.000	0.000
Required C/I [dB]	6.000	6.000
RX Sensitivity [dBm]	-91.990	-91.990
Antenna Gain Rx [dBi]	-5.986	4.958
Cable Loss Rx [dB]	0.000	0.000
Total available path loss [dB]	105.733	105.733
Dimensioning		
Own source interference [%]	0.00	0.00
Other source interf. margin [dB]	3.000	3.000
Fast fading margin [dB]	4.000	4.000
Log normal fading margin [dB]	7.000	7.000
Indoor Loss [dB]	10.000	10.000
Environmental Loss [dB]	3.000	3.000
Performance Gains [dB]	0.000	0.000
Max. permitted prop. loss [dB]	78.733	78.733
Free-Space cell range [m]	83.314	83.314
Erceg C cell range [m]	21.544	21.544
Carrier Frequency [MHz]	2460.000	
Refresh Adjust Antennas		

Figure 56: The Link Budget tab

3 Projects

3.1 Project Settings

Before creating a new project, some adjustments should be done. Extensive adjustments can be made in **Project→Properties** and **Extras→Project Defaults**. The properties refer to the actual project in case it is already open. **Project defaults** are pre-configured settings. It is easier to use those than configure every single project individually. However the layout is the same for both.

3.1.1 General

The following coordinate system types can be chosen:

- UTM (Universal Transverse Mercator)
- Gauss-Krueger
- Geographic

By choosing UTM or Gauss-Krueger a start zone/stripe from the coordinate system can be selected. The earth is scaled in 60 stripes, Germany stands in stripe 32 for example. The cursor is placed on the chosen zone at equator level. The coordinate system type can also be chosen while creating a new project.

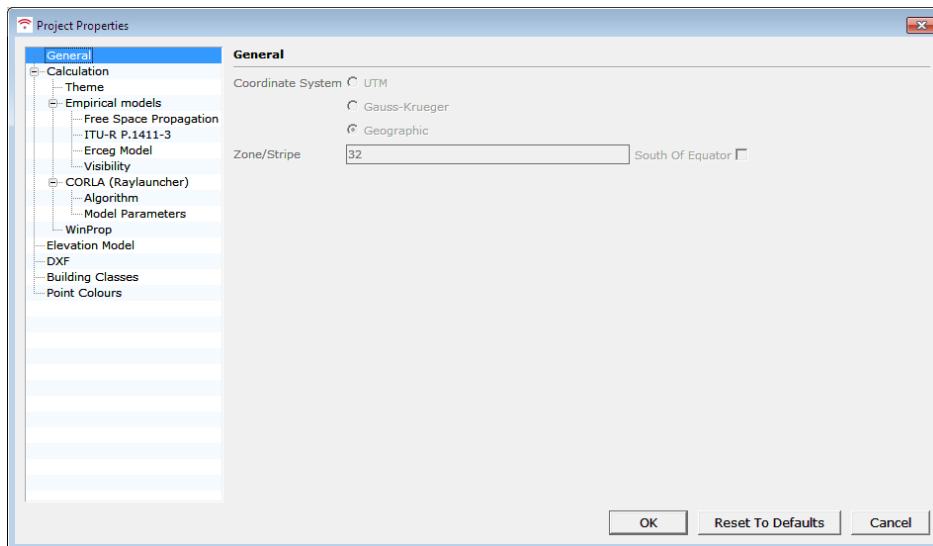


Figure 57: The General Settings tab

3.1.2 Calculation

In the **Calculation tab** it is possible to choose a default propagation **model**. The default setting is the Erceg Model. These propagation models can also be chosen while calculating. The **Maximum** and **Minimum Antenna Area** can be changed if necessary.



A license file is needed to use CORLA. This license is limited to a project and can be ordered at WIMAP-4G product support (info@brown-iposs.eu).

The elevation theme provides **bilinear interpolation** or **nearest neighbour**. The elevation model can also be chosen during a calculation.

- **Nearest neighbour:** Nearest neighbour is an imprecise algorithm. It takes the height of the nearest point which got a value in the elevation model.
- **Bilinear interpolation:** This algorithm is more precise. It considers the closest four neighbours and calculates the average value of their height. That is why it is recommended even if it needs a little bit more processing time (which should not be registered on actual computer systems).



Figure 58: Bilinear interpolation

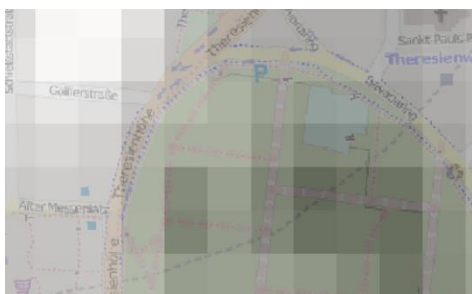


Figure 59: Nearest neighbour

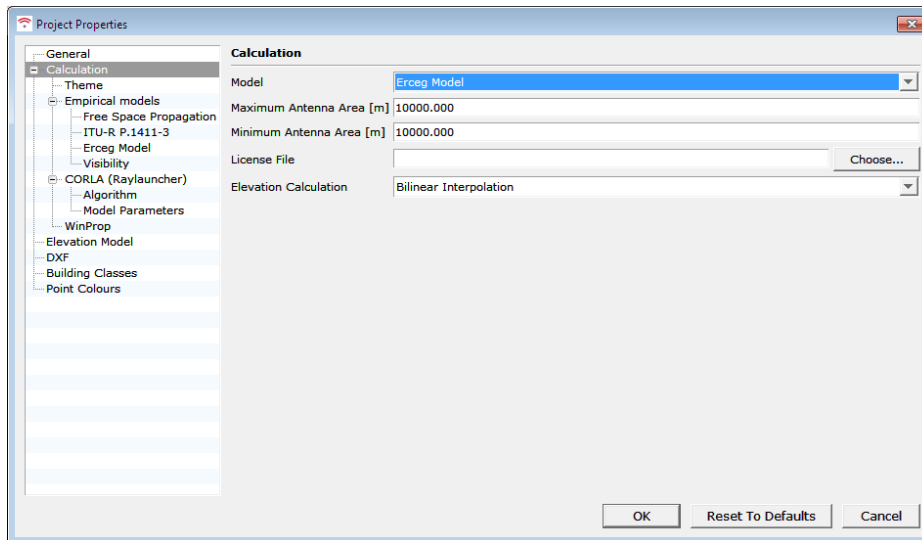


Figure 60: The Calculation Settings tab

3.1.2.1 Themes

The **Theme tab** contains all colour settings of the program. Some improvements should be done if larger projects shall be planned. Default settings are preset for every theme. For large projects additional colours should be added as well as some presets for different locations. Theme settings should always be made in **Project Defaults** to keep them saved for future projects.

Colour profiles can be changed for

- Best Server
- Field Strength
- Power Level
- Sub Carrier Interference
- Carrier to Interferer (C/I)
- Elevation
- Visibility
- Ec/IO

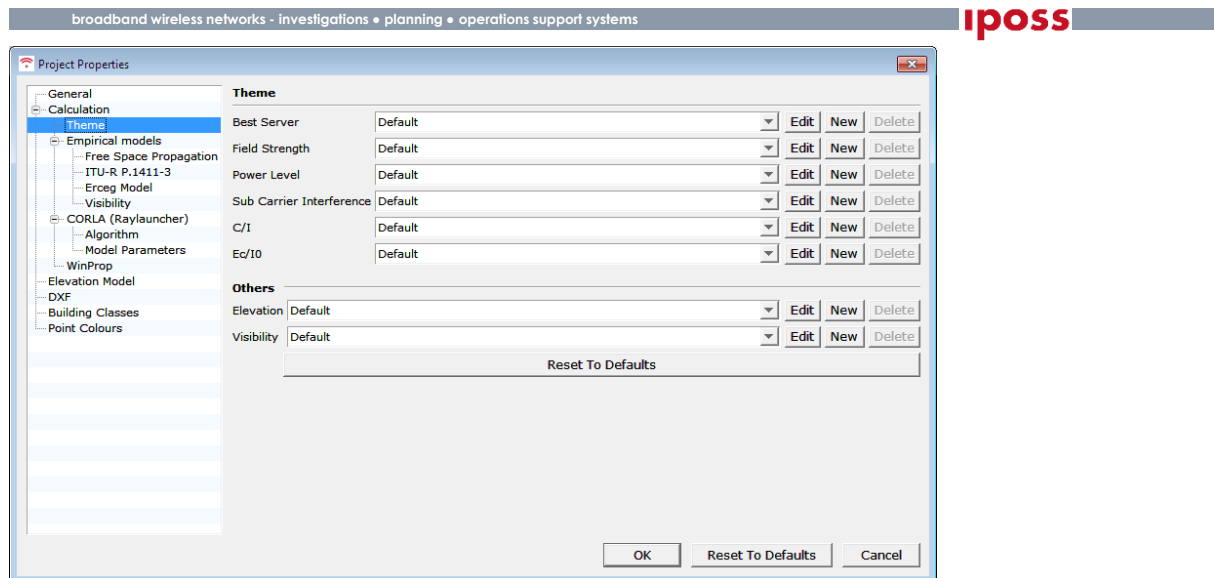


Figure 61: The Theme Settings tab



3.1.2.1.1 How to Change a Colour Profile

1. Open **Extras->Project Defaults->Calculation->Theme**.

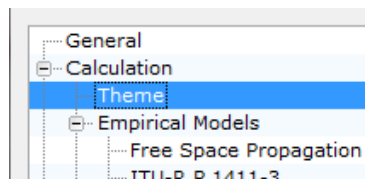


Figure 62: Selecting a theme

2. Select the desired theme, for example **Field Strength**.



Figure 63: Selecting the desired theme

3. Press **Edit** to open the configuration window.

Now there are different possibilities to change a colour profile: Renaming profiles, changing transparency or adding new intervals are possible. **Colour From** and **Colour To** are the colours shown beyond the intervals.

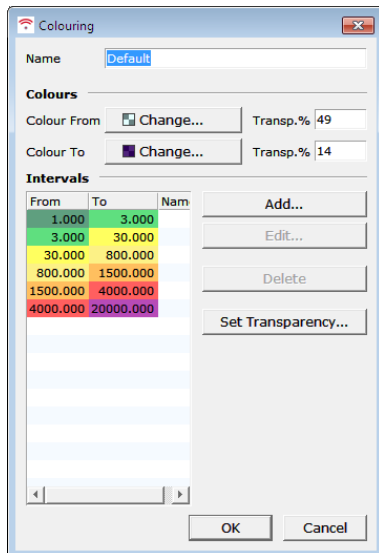


Figure 64: A changed profile

4. Click on **OK** to save the changes.



3.1.2.1.2 How to Add a New Colour Profile

1. Open **Extras->Project Defaults->Calculation->Theme**

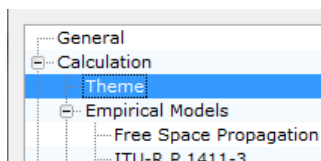


Figure 65: Selecting a theme

2. Select the desired theme, for example **Field Strength**.
3. Press **New** to open the configuration window.

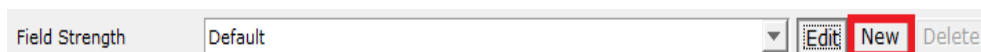


Figure 66: Click on New

4. Name the new profile and change colour. (These are the colours shown beyond the intervals.)
5. Add intervals by selecting **Add**.

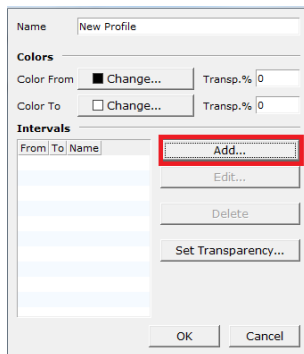


Figure 67: Click Add to add new intervals

6. Fill the required fields (**From**, **To**).

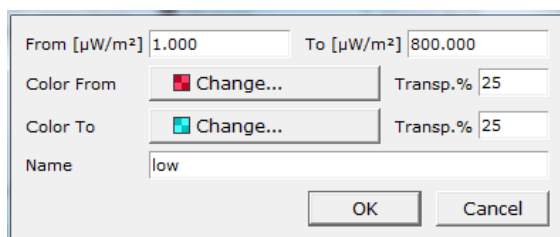


Figure 68: Fill in all fields

7. Choose colours.

8. Name the interval if desired.

9. After adding all desired intervals, press **OK**.

10. Choose a profile for your project.

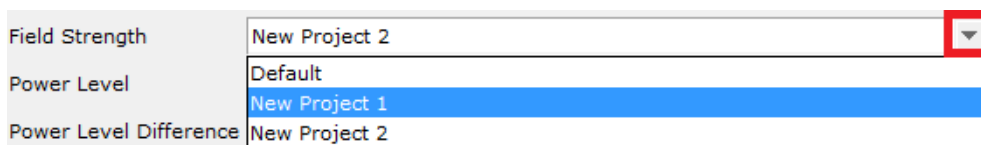


Figure 69: The created profile appears in the list.

All settings can be reset at the bottom by clicking **Reset To Defaults**.

3.1.2.2 Empirical Models

Empirical models are used for propagation calculation. The **resolution** is preconfigured or can be configured manually for new projects. The **resolution** can be calculated absolutely

(in m) or relatively (in %). A **resolution** can also be chosen during a propagation calculation. The WiMAP-4G Community-Edition only allows an absolute value of 50 m. The Professional-Edition allows also resolutions up to centimeters. Furthermore, the **attenuation interpolation** can be changed, too.

The standard setting is the **bilinear interpolation**. It should be the proper setting in general.

Other interpolation models should only be chosen if necessary.

- **Bilinear interpolation:** A precise algorithm that considers the closest four neighbours and calculates the average value of their heights.
- **Nearer of both:** Considers the nearest neighbour and carries its value.
- **Maximum of both:** Considers the closest neighbour with the highest value (best case).
- **Minimum of both:** Considers the closest neighbour with the lowest value (worst case).

The **Pathloss Storage Precision** can be changed to one, two, and four bytes. One byte should only be chosen if there is a large project to plan and only obsolete hardware can be used. There could be an aberration up to half a dB if **1 Byte** is chosen for pathloss. **4 Byte** is very precise but it could take a long time to calculate large projects. With current hardware **4 Byte** is fine.

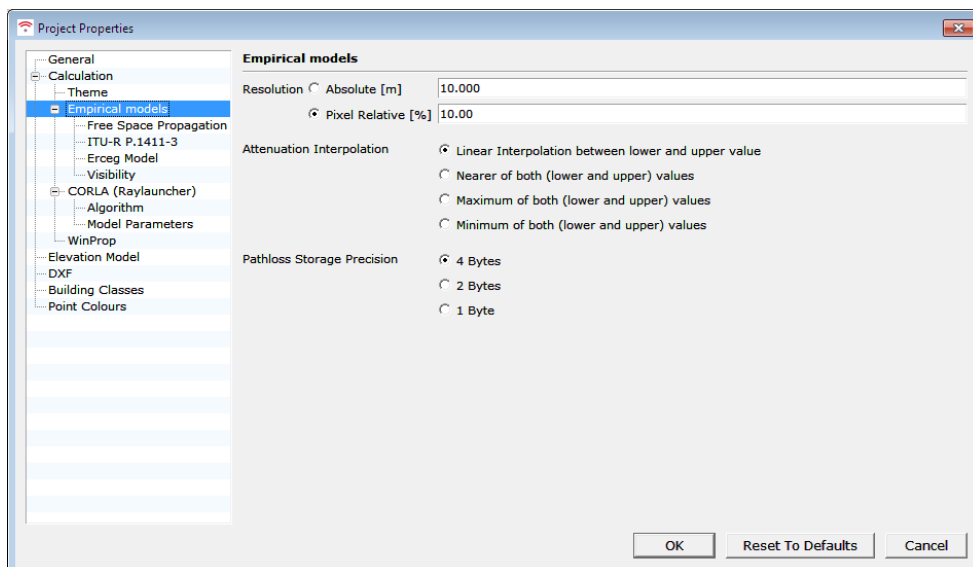


Figure 70: The Empirical Models Settings tab

3.1.2.2.1 Free Space Propagation

The **Free Space Propagation** is a simple but effective propagation model. It is also called equation of radio wave propagation or Friss Model. The free space propagation model is primarily based on the elevation model. Optionally it takes into account visibility restrictions regarding the elevation model and the building model. While this model is not eligible for city centers and strongly cultured regions, it produces good results for suburban and rural regions, plus it is a very fast algorithm. It can help to identify critical regions where detailed measurements need to be done.

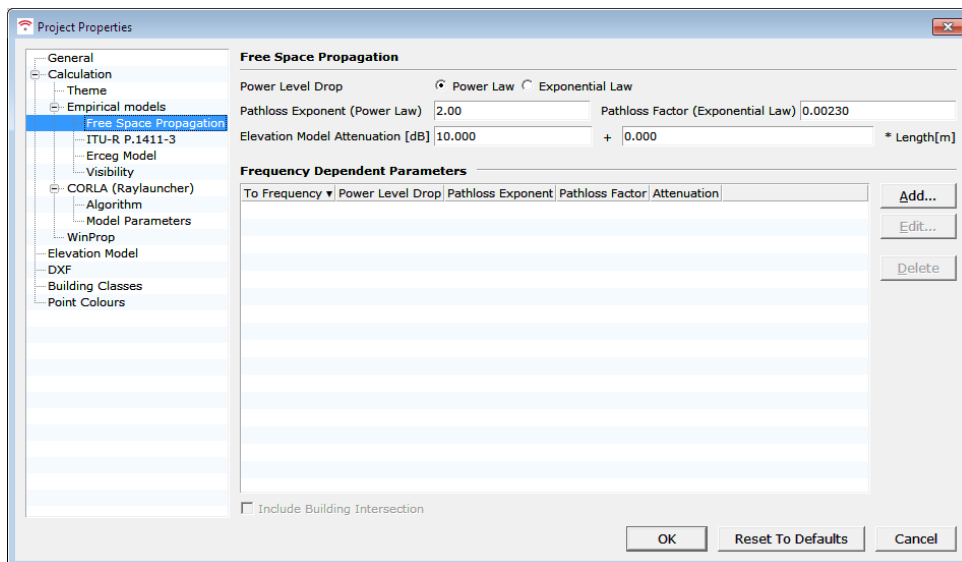


Figure 71: The Free Space Propagation Settings tab

There are two possibilities to calculate the path loss:

- **Power Law** (Lee's model)
 - Calculates the path loss with the power law. To use this option a path loss exponent is required. The path loss exponent comes in 1.6 to 6 depending on the terrain conditions.

Terrain-Type	Path loss exponent
Free space	2
Plain surface	4
City	2.7 – 3.5
City with shadowing effects	3 – 5
Buildings with line of sight	1.6 – 1.8
Buildings without line of sight	4 - 6

Table 1: Path loss exponent

- **Exponential Law**

- Calculates the path loss with the exponential law. To use this option a path loss factor is required. The standard path loss should only be changed by experienced users.

The **Elevation Model Attenuation** can be set to a specific value to take account of obstacles like buildings and mountains or other line of sight interference. The value depends on the structure and its physical conditions. With the help of **frequency dependent parameters** it is possible to create profiles for every frequency in separate. **Building intersection** can be included in calculations at the bottom. It influences the calculation of a project in city areas and considers the fact that structures could stand in line.



3.1.2.2.1.1 How to Add a New Frequency Dependent Parameter for Free Space Propagation

1. Open **Extras->Project Defaults->Calculation->Empirical Models->Free Space Propagation**

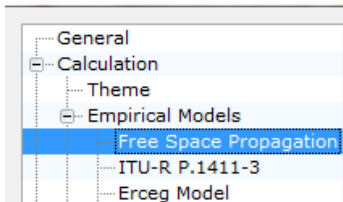


Figure 72: Choose free space propagation model

2. At the bottom of the window click **Add**.

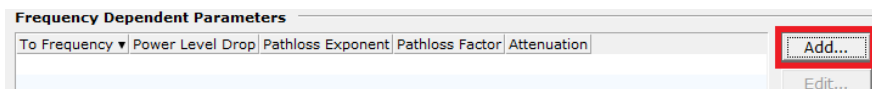


Figure 73: Click Add to add new parameters

3. Choose a **Maximum Frequency** for the profile.
4. Enter a **Pathloss Exponent** and a **Pathloss Factor** and press **OK**. Specific **Pathloss Exponents** can be found at 3.1.2.2.1. The **Pathloss Factor** should be 0.00230 for free space propagation.

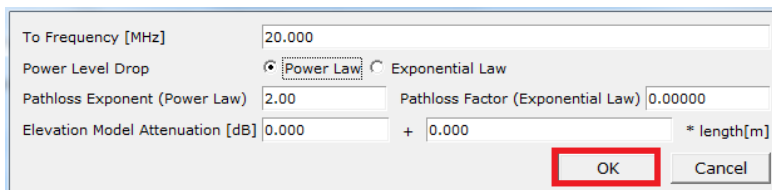


Figure 74: Pathloss exponents and factor

3.1.2.2.2 ITU-R P.1411-3

ITU-R P.1411-3 is a semi-empirical model based on COST 231 Walfish-Ikegami and enhanced by ITU-R. The model considers detailed input data like average height and separation of buildings, street data (width, direction), BS and MS antenna height, length of the path covered by buildings as well as distance from BS to MS.

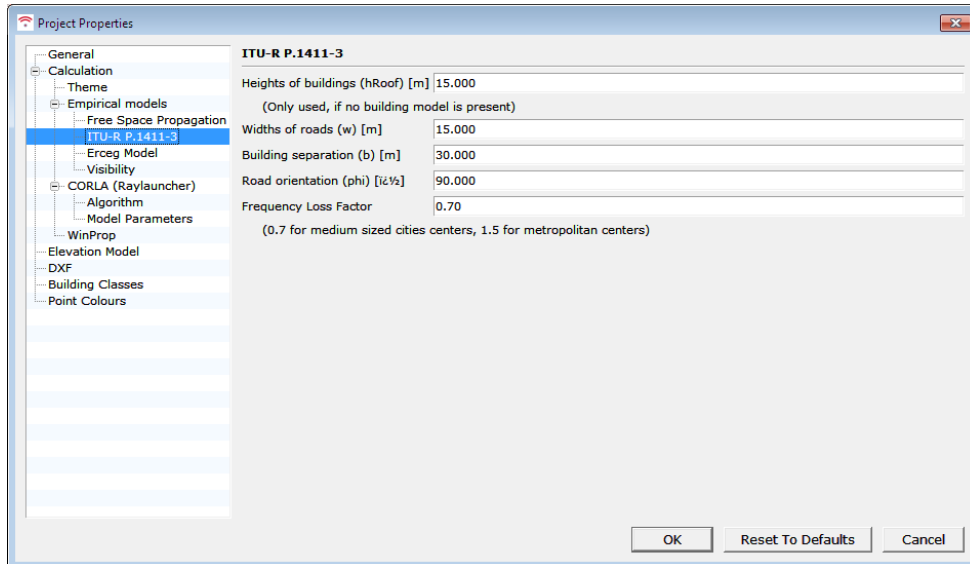


Figure 75: The ITU-R P.1411-3 settings tab

The **ITU-R P.1411-3** settings offer a few settings according to the environment:

- **Maximum height of buildings**
 - This height is only used if there is no elevation model that can be used for calculations. Basically, calculation is more detailed and offers precise results with elevation models.
- **Widths of roads**
 - The width of roads can vary in different cities or villages. It is expressed in meters.
- **Building separation**
 - The building separation describes gap distance between buildings. It is expressed in meters.
- **Road orientation**
 - The road orientation describes the angle between crossing roads. It is expressed in degrees.
- **Frequency Loss Factor**
 - There is the frequency loss factor that should be either 0.7 or 1.5 according to the environment. 0.7 is used for medium sized city centers whereas 1.5 is used for metropolitan city centers.

3.1.2.2.3 Erceg Model

The IEEE 802.16.3c proposes this model developed by Victor Erceg for WiMAX planning. It is designed for suburban and urban areas and considers three Non-Line-of-Sight (NLoS)-scenarios A, B and C:

- Terrain type **A** is a hilly terrain with moderate to heavy tree density and is associated with the highest path loss.
- Terrain type **B** is characterised as a mostly flat terrain with moderate to heavy tree density or a hilly terrain with light tree density.
- Terrain type **C** is a flat terrain with light tree density, producing the lowest path loss.

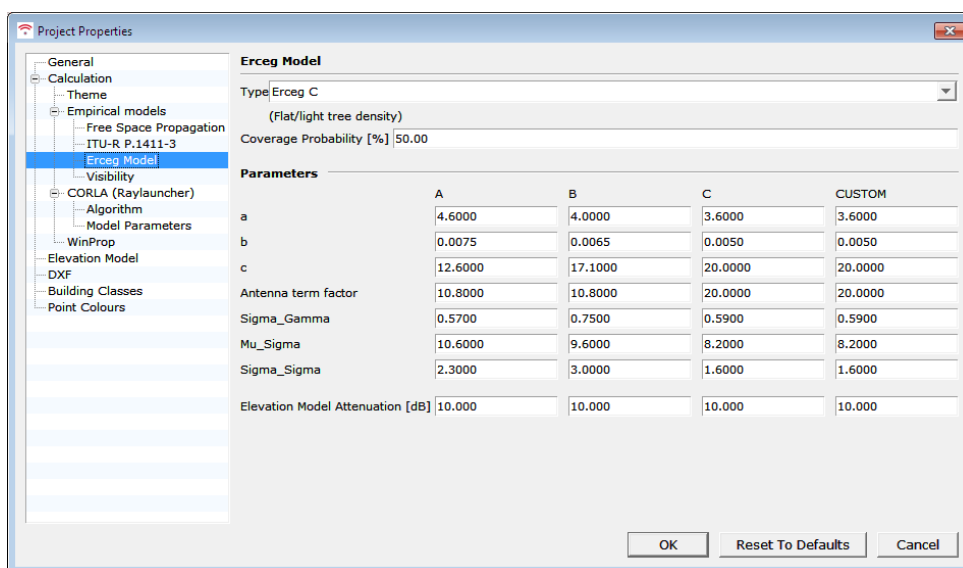


Figure 76: The Erceg Model Settings tab

First of all the decision can be made, which Erceg model should be used by default. If there are only a few trees there is no need to use type **A** by default, in that case Type **C** would be the right decision. Furthermore the coverage probability can be set to a specific value. This probability identifies the chance that gives the customer a specified link quality.

At the bottom all the parameters can be changed for each Erceg model. Changing the parameters from Erceg **A**, **B** and **C** should only be done by experienced users. All other users could get some experience in changing the custom model.

These three parameters for the path loss exponent, which is variable over the population of macro cells within each terrain category should only be changed for extreme terrain conditions.

Antenna-Term Factor:

Sigma-Gamma:

Sigma-Mu:

Sigma-Sigma:



Data derived constant for each terrain type

Only experienced users should change these.

3.1.2.2.4 Visibility

Some visibility settings can be changed according to the elevation theme and building intersection. First of all it is possible to change the **Elevation Model Visibility** type. The types, **Bilinear Stepwise** or **Bilinear Cellwise**, can be chosen.

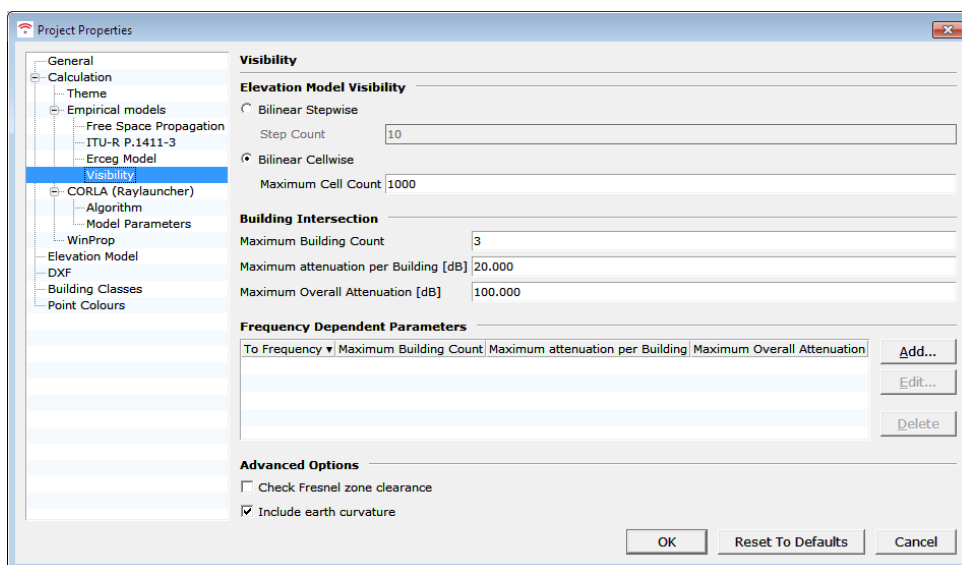
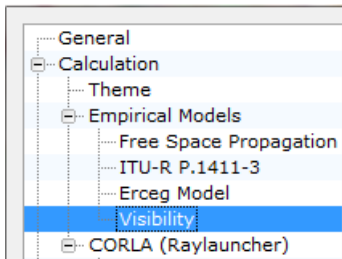
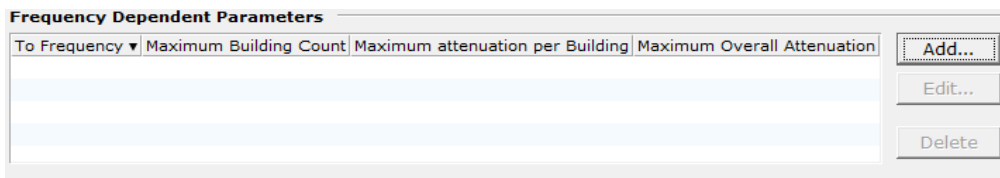
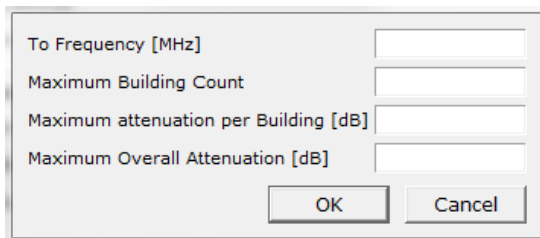


Figure 77: Elevation model visibility

The next settings concentrate on the **Building Intersection**. These settings would be important if the project was planned in areas with a lot of buildings like city centres. First thing to decide is the **Maximum Building Count** for the building intersection. This parameter depends on the **Maximum Attenuation per Building** and the **Maximum Overall Attenuation**. The maximum building count multiplied with the maximum attenuation per building should not be higher than the maximum overall attenuation. This feature should only be used if the maximum attenuation per building is known. For the advanced user it is also possible to add **Frequency Dependent Parameters**. If the attenuation is well-known, frequency dependent parameters can help a lot in getting results close to reality.

**3.1.2.2.4.1 How to Add a New Frequency Dependent Parameter for Building Intersection****1. Open *Extras->Project Defaults->Calculation->Empirical Models->Visibility*****Figure 78: Visibility of empirical models****2. At the bottom part of the window in the frequency dependent parameters window, click on *Add*.****Figure 79: Click Add to add new parameters****3. A new window opens and some values need to be added.****Figure 80: Fill in all fields**

- **To Frequency:** The maximum frequency for attenuation (for example 2.4 GHz)
- **Maximum Building Count:** The maximum count of intersecting buildings
- **Maximum Attenuation per Building:** The maximum attenuation one building can achieve
- **Maximum Overall Attenuation:** The maximum attenuation that can be reached if a lot of buildings intersect

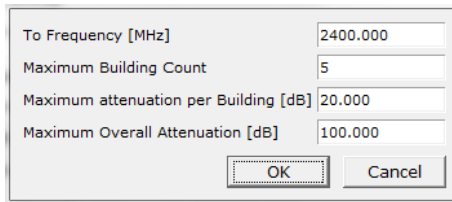


Figure 81: Click OK to save the changes

4. Click on **OK** to add the new frequency dependent parameter.
The new parameter is created and will be used in the project.

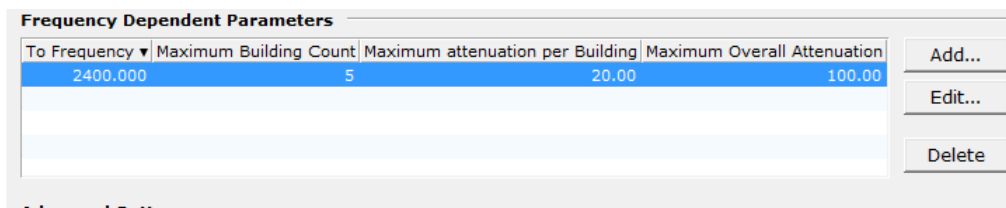


Figure 82: The created parameter appears in the list

3.1.2.3 CORLA (Raylauncher)

CORLA (Cube Oriented Ray Launching Algorithm) is a powerful propagation model based on the 3D raylaunching technology. CORLA provides a cube based representation of the area which leads to fast identification, processing of diffraction and reflection sources. Different antenna patterns, delay spread and building penetration are inherent features of the algorithm. Hence CORLA is optimized for speed, it is 20 to 40 times faster than other ray launching solutions and therefore qualified to be used in WiMAP-4G. Due to the complexity of the CORLA Raylauncher, there are many adjustments to be done to optimise it for a better use in the current project.

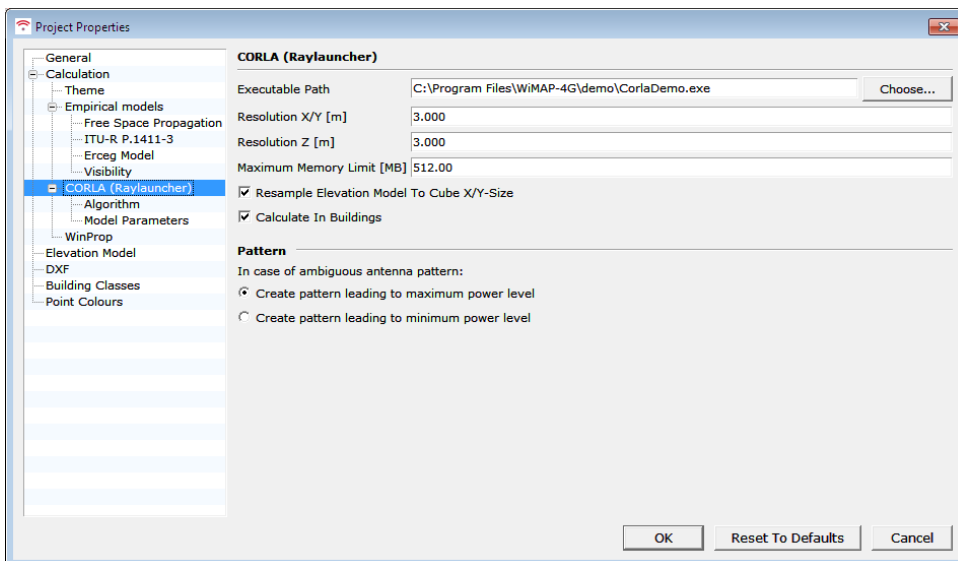


Figure 83: The CORLA Settings tab

First of all the **executable path** to the **CORLA.exe** needs to be set. This always needs to be done prior to make a calculation with the CORLA raylaunching algorithm.



The CORLA Raylauncher requires an extra license. It can be ordered at the WiMAP-4G product support. Contact info@brown-iposs.eu for more information.

The next two options deal with the resolution used while calculating something with the CORLA Raylauncher:

- **Resample Elevation Model To Cube X/Y Size:** Activating this option forces the CORLA algorithm to load and resample the elevation model. This is important for small areas since CORLA needs a specific minimal resolution of the elevation model to be able to calculate. If this resolution cannot be provided of the elevation model used in the project, activate this option.
- **Calculate in Buildings:** Choose whether to calculate inside buildings or not. At the bottom of the window antenna pattern options can be found. As already mentioned, CORLA holds antenna patterns, which can be used in case ambiguous antenna patterns are used in the current project. Choose between **Create pattern leading to maximum power level** or **Create pattern leading to minimum power level**.

3.1.2.3.1 Algorithm

The **Algorithm tab** offers a few possibilities to adjust the accuracy of the CORLA Raylauncher.

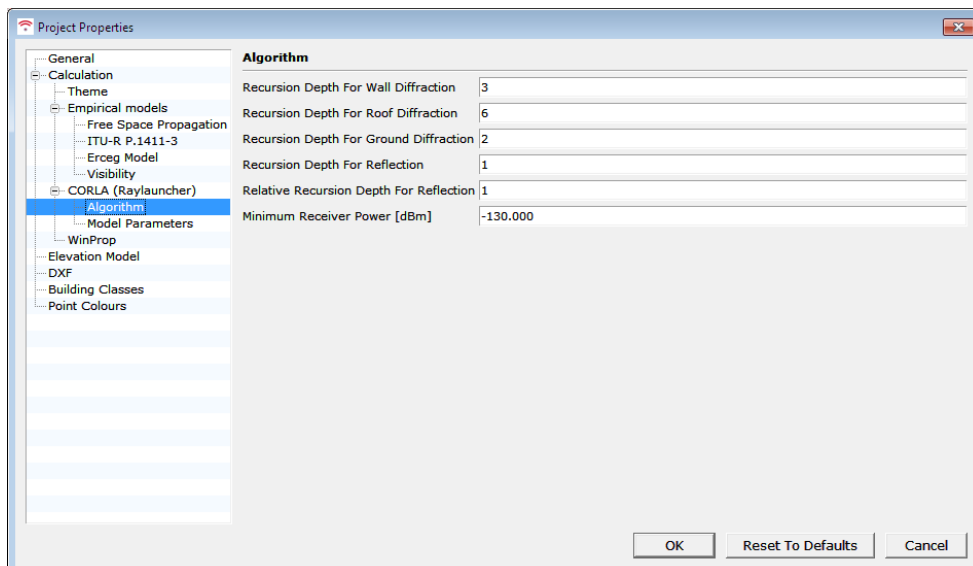


Figure 84: The CORLA Algorithm tab

The parameters are mostly self-explanatory:

- **Recursion Depth For Wall Diffraction:** The number of walls which could diffract the signal
- **Recursion Depth For Roof Diffraction:** The number of roofs which could diffract the signal
- **Recursion Depth For Ground Diffraction:** Maximum number of signal diffraction by the ground
- **Recursion Depth For Reflection:** Maximum number of signal reflection by anything
- **Relative Recursion Depth For Reflection:** Relative number of signal reflection by anything
- **Minimum Receiver Power:** Minimum receiver power that can be transformed into a usable signal

Editing these parameters should only be done by experienced users who are familiar with the CORLA algorithm and can assess the consequences of changing these parameters. The default parameters offer a good quality and also a fast calculation. Choosing higher numbers for reflections or diffractions can extend the calculation time for many hours or even days.

3.1.2.3.2 Model Parameters

The model parameters offer full access to the algorithm parameters. Hence this algorithm is very complicated, the model parameters should only be changed by experienced users.

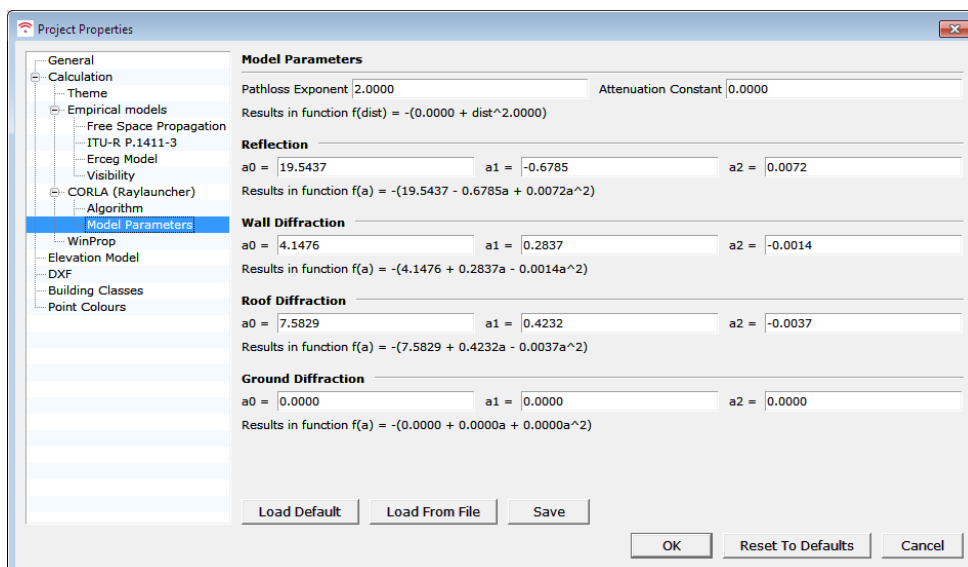


Figure 85: The CORLA Model Parameters tab

At the bottom of the window, it is possible to import a model parameter file in the actual project. This enables the user to share configuration files between projects. The actual

configuration can also be saved by clicking on **Save**. Furthermore it is possible to set the configuration to the default parameters by clicking on **Load Default**.



Do not change CORLA parameters if you are not 100 % sure what you are doing. Since the CORLA Raylauncher is not developed by brown-iposs, further information can only be gathered from TNC. The WiMAP-4G product support (info@brown-iposs.eu) will open the contact on request.

3.1.2.4 WinProp

WinProp is for propagation modeling in different scenarios (like rural, indoor, and outdoor). In this version, only click on Rural.

The **Dominant Path Model** which is included in WinProp calculates the path loss on the main paths between transmitter and each receiver pixel by high precision like the ray tracing.

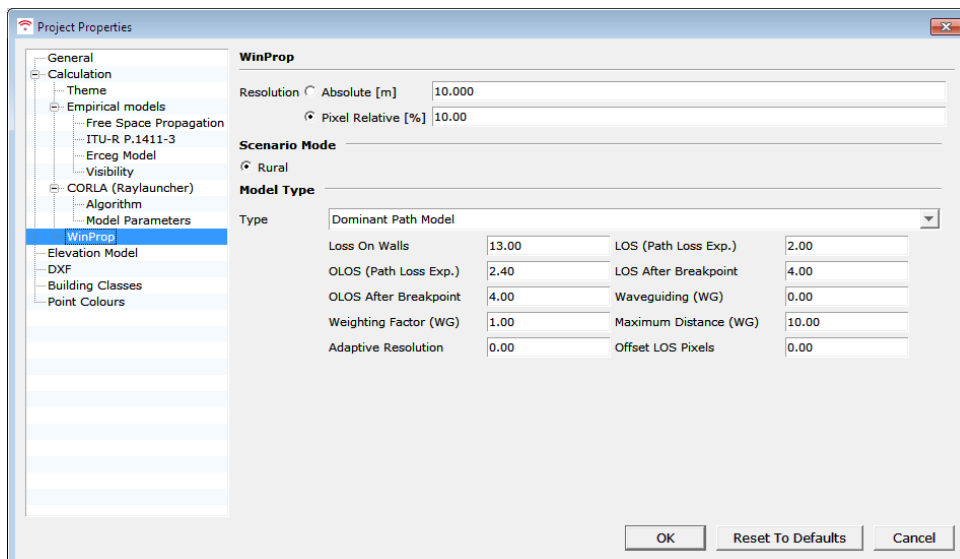


Figure 86: The WinProp properties



OLOS: = NLOS = non-light-of-sight connection

LOS: light-of-sight connection

WG: Waveguiding

3.1.3 Elevation Model

In the **Elevation Model** settings the standard environment elevation can be changed in case of there is no elevation model data available for the project. Elevation can be changed by activating **Use default elevation in case of missing elevation data** and specifying a

value. Furthermore, it can be decided if ASCII grid files should be specified on xllcenter or xllcorner.

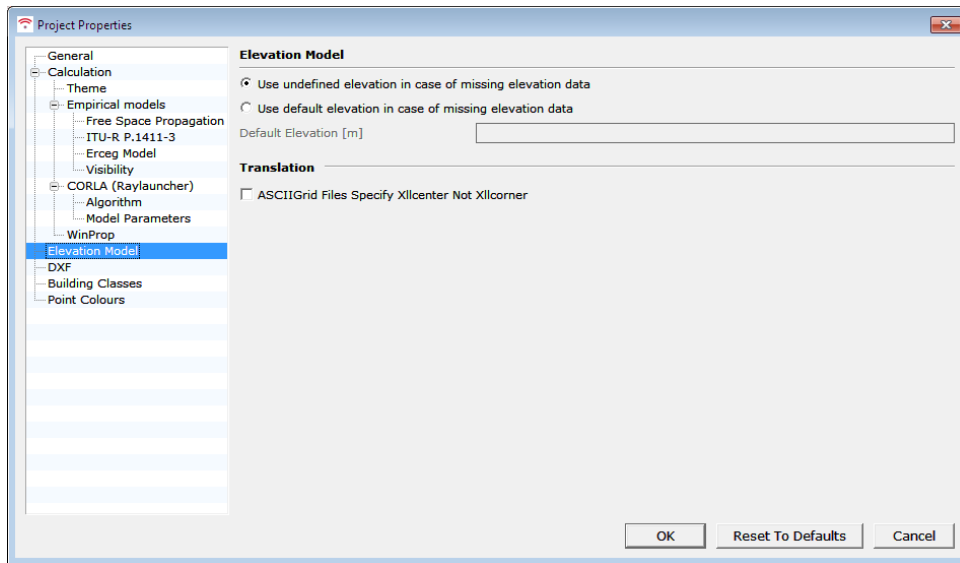


Figure 87: The Elevation Model settings

3.1.4 DXF

There is no need for explaining .DXF settings here. It gets important while importing cadastral data. For .DXF settings see 4.1.2.

3.1.5 Building Classes

The **Building Classes** submenu allows the user to create new buildings or wood profiles. This is important while creating buildings or wood. For example one class of buildings cannot overlap itself, so if the user wants to create nested buildings he needs to create more than one class of buildings. It is the same for wood.

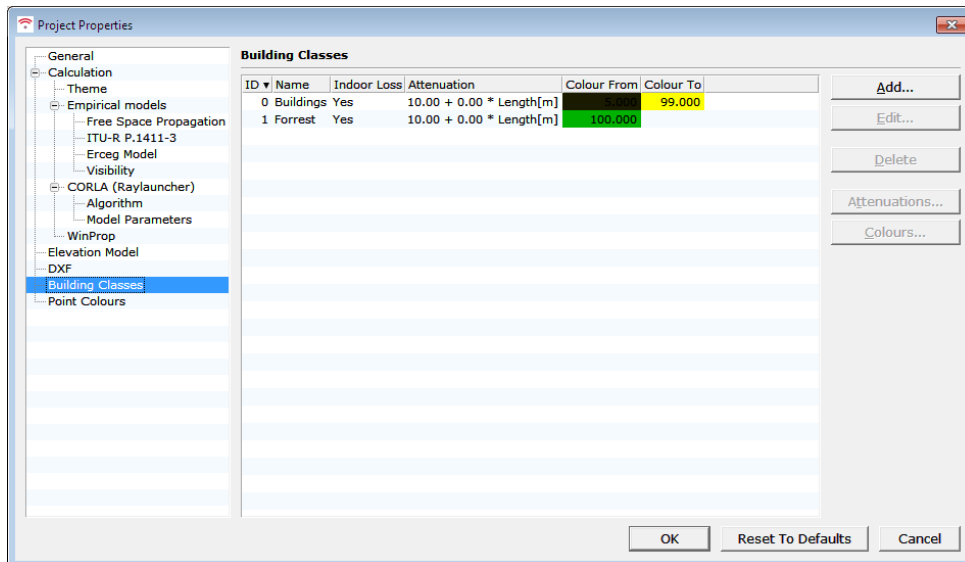


Figure 88: The Building Classes settings



3.1.5.1 How to Add a Building or Wood Profile

1. Open **Extras** → **Project Defaults** → **Building Classes**.

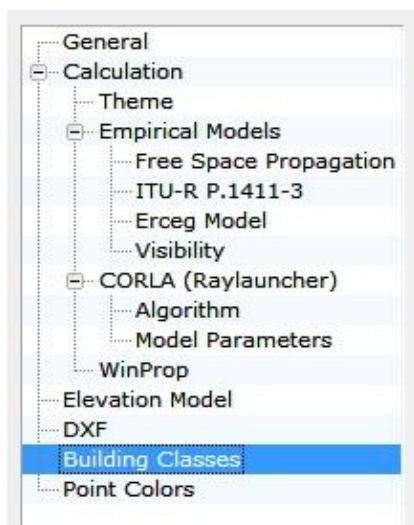


Figure 89: Select building classes

2. Click on **Add**.

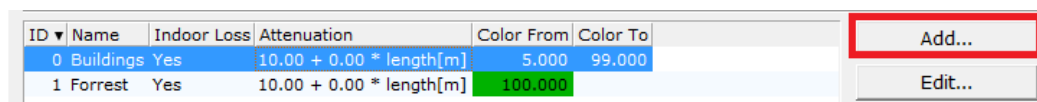
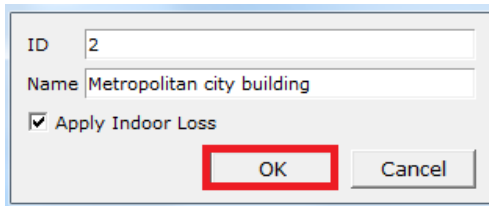


Figure 90: Click Add to add a new building class

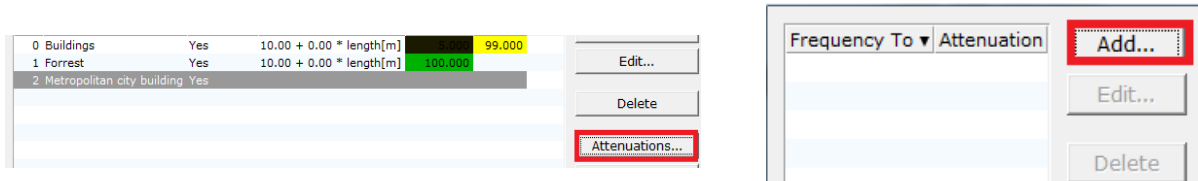
3. Type in next **ID** and **Name** and click on **OK**. Indoor loss should be applied except when there are no walls or doors etc.



ID: 2
 Name: Metropolitan city building
☒ Apply Indoor Loss
 OK Cancel

Figure 91: Click OK to save the changes

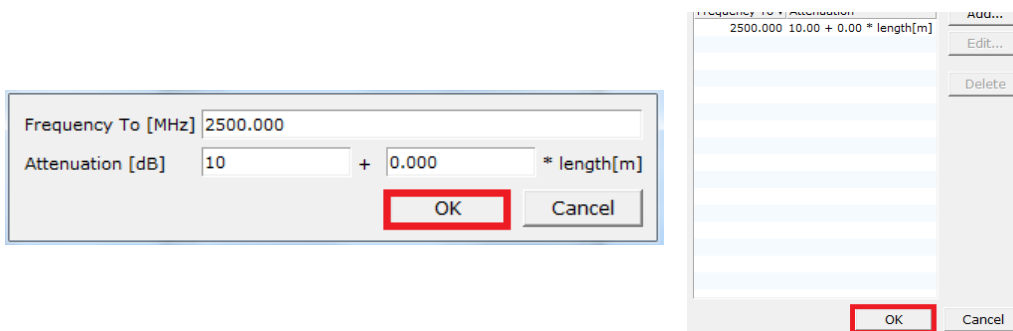
4. Select the new building from the list and click on **Attenuations** and then on **Add**.



Buildings list:
 0 Buildings Yes 10.00 + 0.00 * length[m] 99.000
 1 Forrest Yes 10.00 + 0.00 * length[m] 100.000
 2 Metropolitan city building Yes
 Attenuations...
 Frequency To Attenuation Add... Edit... Delete

Figure 92: Add new attenuation parameters

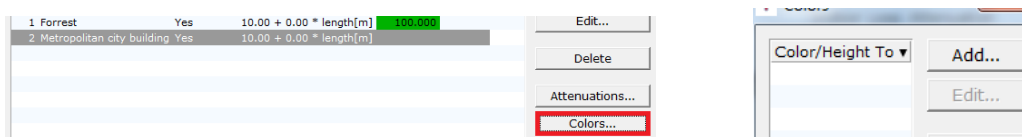
5. Add new **Frequency** and **Attenuation**. The second field should only be filled if there are some special circumstances inside the building. **Double-click on OK**.



Frequency To [MHz]: 2500.000
 Attenuation [dB]: 10 + 0.000 * length[m]
 OK Cancel
 Buildings list:
 2500.000 10.00 + 0.00 * length[m] Add... Edit... Delete
 OK Cancel

Figure 93: Save the changes with OK

6. Click on **Color** and **Add**.



Buildings list:
 1 Forrest Yes 10.00 + 0.00 * length[m] 100.000
 2 Metropolitan city building Yes 10.00 + 0.00 * length[m]
 Edit... Delete Attenuations... Colors...
 Color/Height To Add... Edit...

Figure 94: Colours need to be added

7. Gradually insert building heights and the related desired colours. After this is done, **double-click on OK**.

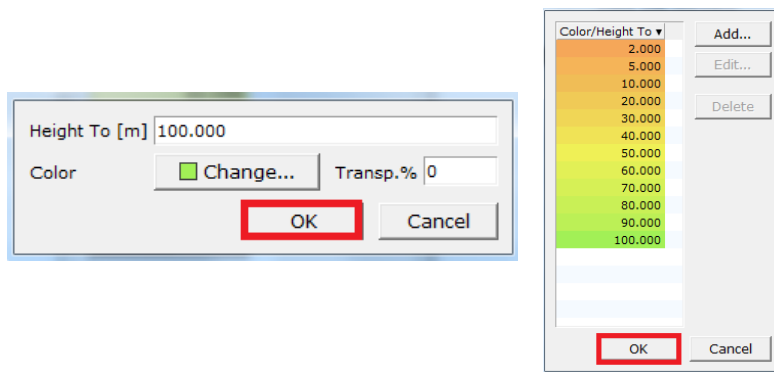


Figure 95: Click OK to save all changes

This works for wood, too.

3.2 Create Projects

After configuring the project settings, it is time to create a real project.

A new project can be created:

- during the start of WiMAP-4G

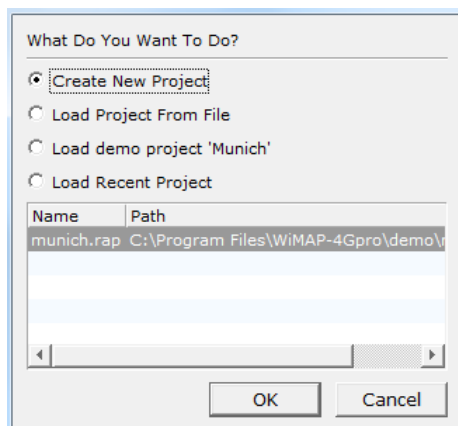


Figure 96: The start dialogue

- by choosing **Project** → **New** while WiMAP-4G is running. Current projects can be saved or discarded.

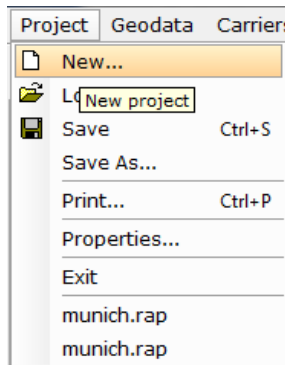


Figure 97: Create a new project

The **Create Project Dialogue** appears.

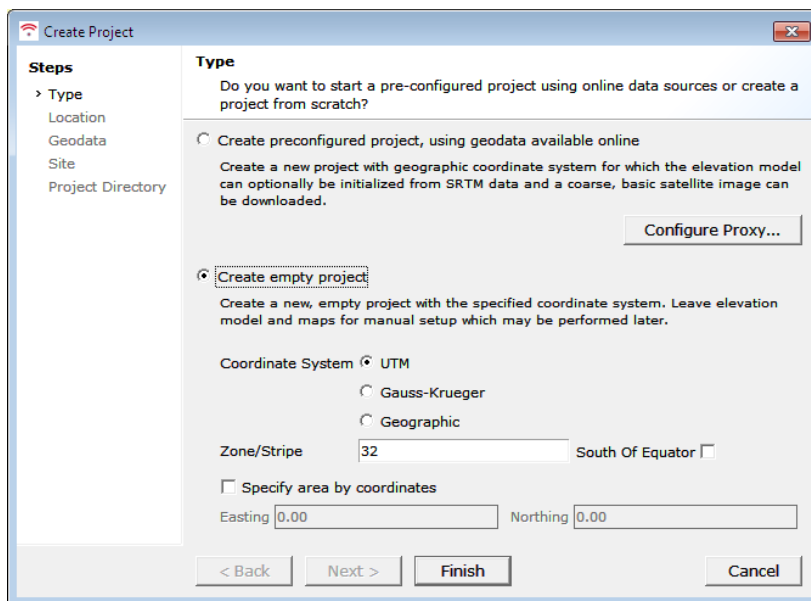


Figure 98: Dialogue for creating a project

There are two ways to create a new project:

- Create a preconfigured project with elevation model.
- Create an empty project.

3.2.1 Create Preconfigured Projects

This option creates a new project with a geographic coordinate system. An elevation model can optionally be initialized from SRTM data and a basic satellite image can be downloaded. This is the easiest way to create a project because the elevation model can be initialized during creation.



Creating a preconfigured project requires internet connection. If a proxy is in use, optional proxy settings should be done by clicking "Configure Proxy..."



3.2.1.1 How to Create a Preconfigured Project

1. Open **Project**→**New** or choose  from the Control Bar.
2. Choose **Create preconfigured project, using geodata available online** and click on **Next**. If a proxy server is in use, configure WiMAP-4G by clicking on **Configure Proxy**.

Steps	Type
> Type - Location - Geodata - Site - Project directory	Do you want to start a pre-configured project using online data sources or create a project from scratch? ☒ Create preconfigured project, using geodata available online Create a new project with geographic coordinate system for which the elevation model can optionally be initialized from SRTM data and a coarse, basic satellite image can be downloaded. Configure Proxy...

Figure 99: Choose this type and click Next

3. Specify the area **by address** or **by coordinates**.

These are the two possibilities to specify an area for the geodata download. Specifying an area **by address** is the easiest method which allows the user to enter a name of a place or a zip-code or to choose an area from the result list. To specify an area **by coordinates** the correct longitude and latitude is required.



If coordinates are unknown they can be found easily by using <http://maps.bing.com> or Google Earth™. Look at 3.2.1.1.1 for more information.

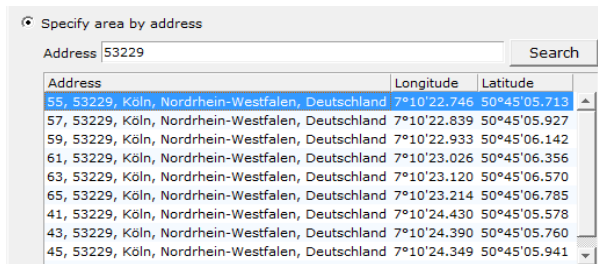
3.1 Specify area by address

Insert name of a place or zip code and click on **Search**.

Location						
Select the location/area of your project either by address or directly by coordinates.						
☒ Specify area by address						
Address 53229 Search						
<table border="1"> <thead> <tr> <th>Address</th> <th>Longitude</th> <th>Latitude</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Address	Longitude	Latitude			
Address	Longitude	Latitude				

Figure 100: Specify an area by address

Choose from the result list and click on **Next**.



Address	Longitude	Latitude
55, 53229, Köln, Nordrhein-Westfalen, Deutschland	7°10'22.746	50°45'05.713
57, 53229, Köln, Nordrhein-Westfalen, Deutschland	7°10'22.839	50°45'05.927
59, 53229, Köln, Nordrhein-Westfalen, Deutschland	7°10'22.933	50°45'06.142
61, 53229, Köln, Nordrhein-Westfalen, Deutschland	7°10'23.026	50°45'06.356
63, 53229, Köln, Nordrhein-Westfalen, Deutschland	7°10'23.120	50°45'06.570
65, 53229, Köln, Nordrhein-Westfalen, Deutschland	7°10'23.214	50°45'06.785
41, 53229, Köln, Nordrhein-Westfalen, Deutschland	7°10'24.430	50°45'05.578
43, 53229, Köln, Nordrhein-Westfalen, Deutschland	7°10'24.390	50°45'05.760
45, 53229, Köln, Nordrhein-Westfalen, Deutschland	7°10'24.349	50°45'05.941

Figure 101: Choose a result from the list

3.2 Specify area by coordinates

*Insert longitude and latitude into the corresponding fields and click on **Next**.*

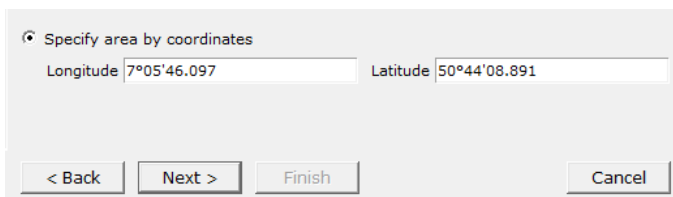


Figure 102: Specify an area by coordinates

- Here it is possible to download the geodata from the internet. Missing SRTM (**Shuttle Radar Topography Mission**) values can also be selected, which induces the program to interpolate the missing areas.



The Shuttle Radar Topography Mission (SRTM) is a NASA mission conducted in 2000 to obtain elevation data for most of the world. It is the current dataset of choice for digital elevation model data (DEM) since it has a fairly high resolution (about 90 meters at the equator, and <30 meters in the U.S.), has near-global coverage (from 56° S to 60° N), and is released into the public domain.

Furthermore a satellite image can be downloaded from OnEarth. The last setting is the radius in meters. It specifies the maximum area which propagation models can be calculated in.

If all settings are done, *click on **Next**.*

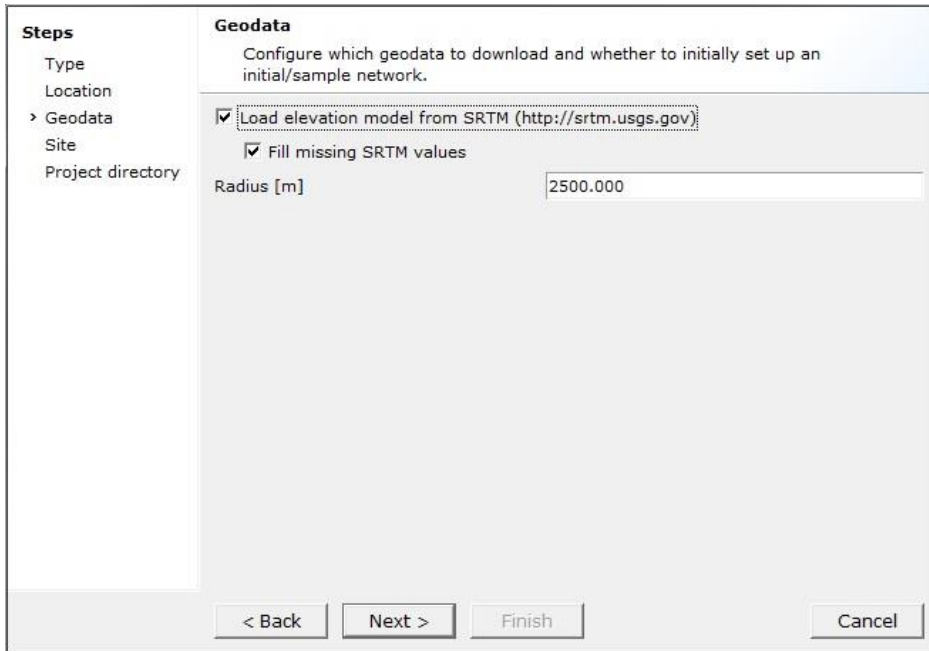


Figure 103: Choose the radius of the area



Changing the maximum size of an area at a later date is possible by deleting elevation and loading it newly from internet. However a bigger area is always a good choice even if the download takes a little bit longer to avoid the need for later modification.

5. Choose if an example site should appear on the map or not. If yes, choose whether it should be a site with three sector antennas or one omega antenna and decide on one of the technologies.

Click on **Next**.

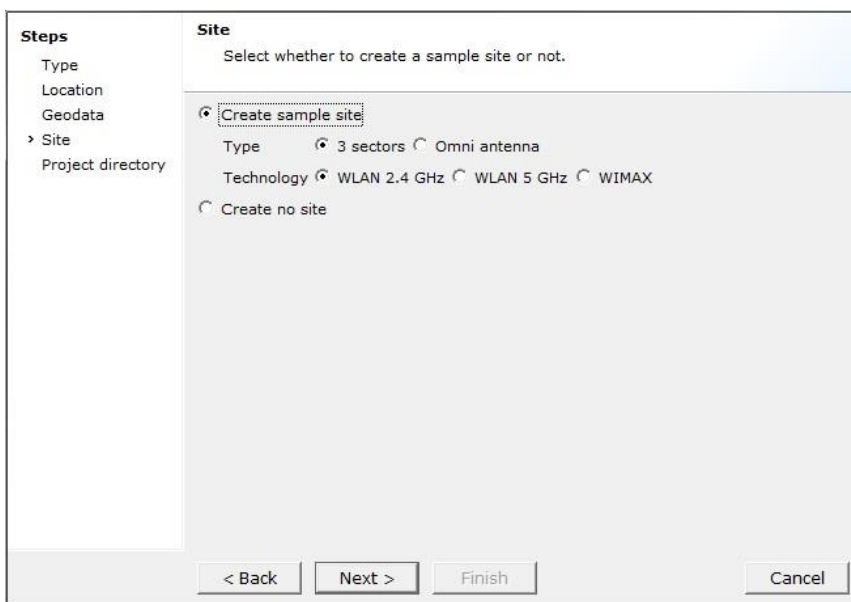


Figure 104: Choose an example site

6. *Choose a project folder.* A folder for a new project must be an empty folder. *New folders can be created by right-clicking on the desired location and clicking on **Create**. Select this new Folder and press **Finish**.*
Now the project has been created successfully and the user can start working.



3.2.1.1.1 How to Find Specific Geographic Coordinates with Google Maps™

1. *Open <http://maps.google.com> and search for the specific area.*

Example: Bonn, Germany

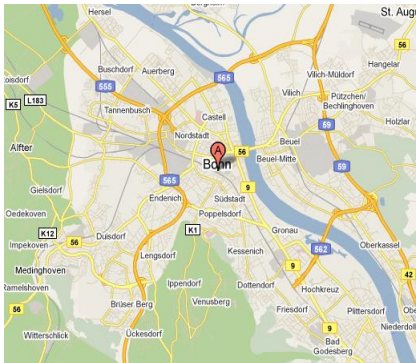


Figure 105: Open Google Maps™

2. *Right click on the red marker and select **What's here?***



Figure 106: Right-click the red marker

3. Now the specific coordinates appear in the search bar whereat 50.639062 is the latitude and 7.094765 is the longitude.

50.739062,7.094765

Figure 107: The coordinates

4. *Copy longitude and latitude to WiMAP-4G (Please make sure that project coordinates are set to Geographic Coordinates).*

3.2.2 Create Empty Projects

This option creates a new empty project. The coordinate system type can be specified, elevation model and satellite images can be imported later.



An empty project does not need to be saved while creation.



3.2.2.1 How to Create an Empty Project

1. Open **Project**→**New** or choose  from the Control Bar.
2. Choose **Create empty project**.
3. Choose a coordinate system (**UTM**, **Gauss-Krueger**, **Geographic**).

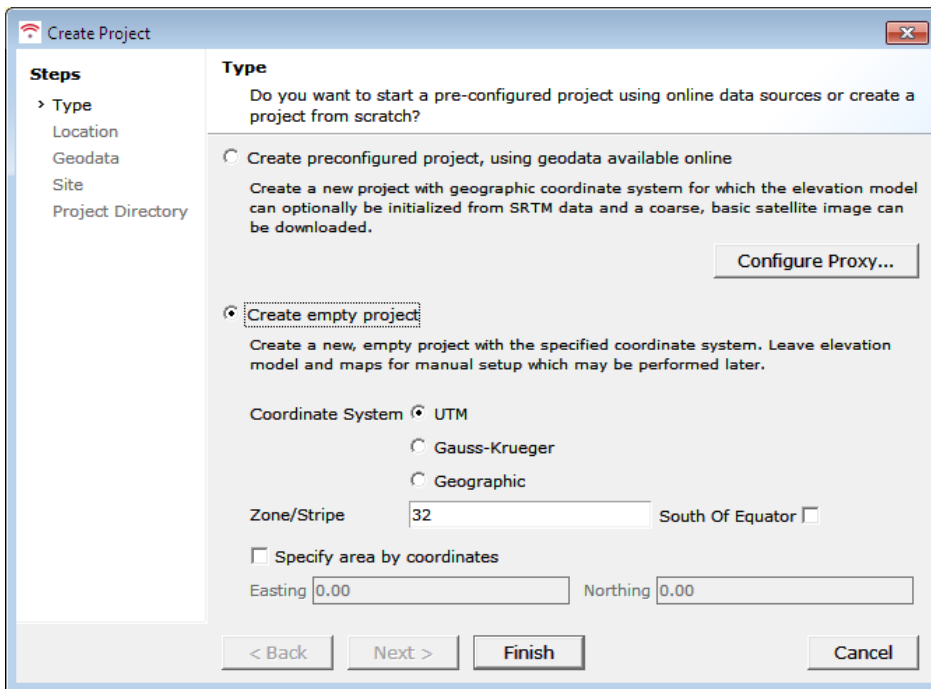


Figure 108: Choose a coordinate system type



UTM: The "Universal Transverse Mercator" System is a coordinate system that makes it possible to locate every point on earth with the help of two length declaration. Therefore it splits the earth in 6° wide zones. The X-value represents the distance between a point and the meridian of origin while the Y-value represents the distance between a point and the equator. Both values are specified in meter. The Universal Transverse Mercator coordinate System more and more displaces the Gauss-Krueger system.

Gauss-Krueger: The Gauss-Krueger system is based on the same technique

as UTM but splits the earth in 3° wide Zones instead of 6° like UTM.

Geographic: The geographic coordinate system is the standard system used by OpenStreetMap™ and Google™. Every point on earth can be specified by an X- and Y-coordinate which are specified in degree. The X-coordinate can have a value between -180° and 180° while the Y-value can be everything between -90° and 90°. A location can be specified more precisely by using angular minutes and seconds (angular seconds are decimal numbers, too).
0.001 angular second = 0.5 m.

4. If **UTM** is chosen, *decide on a zone/stripe, if this zone/stripe in the south of the equator, select this option and insert coordinates of a specified area.* The default zone 32 is the zone where Germany is located in.

If **Gauss-Krueger** is chosen, select the option south of the equator if the area is there and optionally insert coordinates of the specified area.

If **Geographic** is chosen, it is sufficient to insert coordinates of the specified area only.

5. Click on **Finish**.

An empty project is created and imports can be done later. For more information see the following chapters.

3.3 Load Projects

Projects can be loaded by *choosing **Project→Load** or clicking  on the Control-Bar.* The **File Explorer** will open and a project file (.rap) can be chosen. If there is an active project, it is possible to save or discard it, before loading a new project. Recent projects are shown on the project submenu at the bottom.

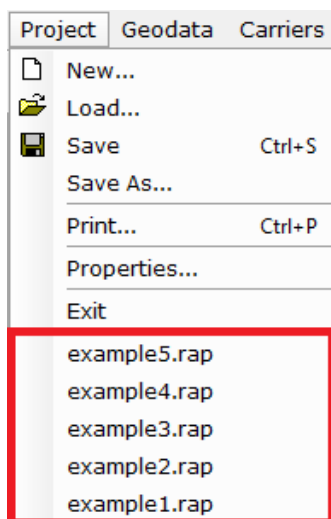


Figure 109: The easy way to load projects

3.4 Save Projects

Projects can be saved *by choosing **Project→Save** or clicking  on the Control-Bar. **Save as** can also be chosen from the Project submenu. With **Save as**, a project can be renamed or saved at another location.*



Projects can also be saved with the Shortcut STRG+S.

3.5 The Log

The log is an useful tool to help the user identify problems if something does not work. It is a separate window and therefore it can be observed while working in the program. The log can be found at the bottom of the user interface of WiMAP-4G (by default).

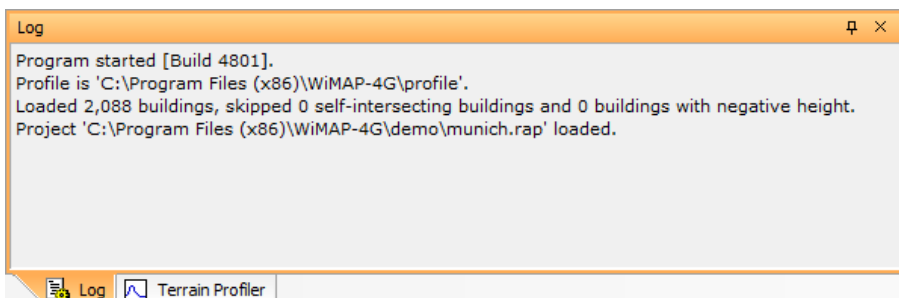


Figure 110: The log window

After loading a project, the log starts protocolling everything for a better overview to relate to every step of the work. Nearly every action of the log except interface actions will be protocolled, for example shifting the area or zooming in and out. To learn what happened or what caused a problem take a look at the log first. Errors are written in red colour for better identification. Warning messages are highlighted in blue.

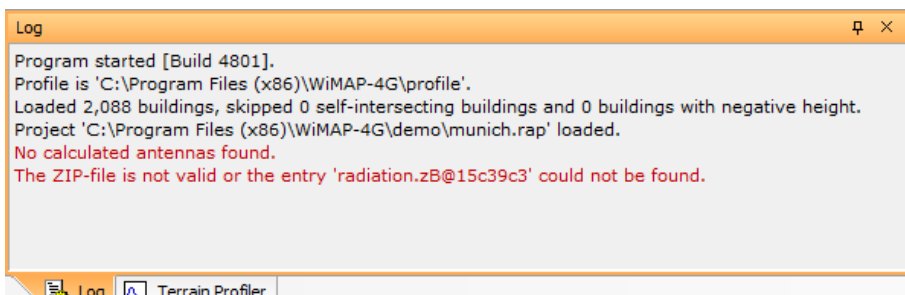


Figure 111: Errors are shown in red in the log window.

4 Geodata

Importing geodata is one of the most important things to bear in mind while working on a project. Geodata makes sure that the user takes account of elevation, buildings, wood and other environmental factors. Cadastral data, elevation models and background images can be imported in WiMAP-4G.



A professional project should never be planned without geodata import because it affects the results in a certain extent.

4.1 Cadastral Data

Cadastral data is a comprehensive register of the land parcels of a country or parts of a country. It includes the precise location, dimension and the cultivation of an individual parcel. Cadastral data can be purchased at the local land survey register. For presentations, it can be useful to see the exact data signal power for a customer. The destination of a site can be planned better if the user knows what is out there. Cadastral data is not as important as a good elevation model, but it can help the user to get an idea of the environment and take account of some special circumstances which may exist. Import cadastral data in .dxf, meaning "direct interchange format".



4.1.1 How to Import Cadastral Data

1. Open **Geodata** and choose **Load Cadastral Data**.

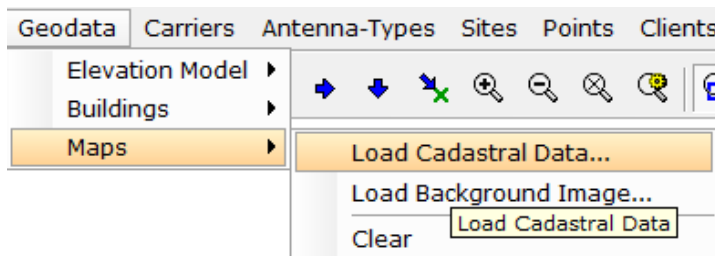


Figure 112: Load cadastral data

2. When the configuration window appears some settings need to be done. It is possible to import single as well as multiple cadasters.
*Activate single or multiple file import and click on **Choose**.* Choose a file or a folder to import multiple files. If the file path is known, it can be entered directly into the box.

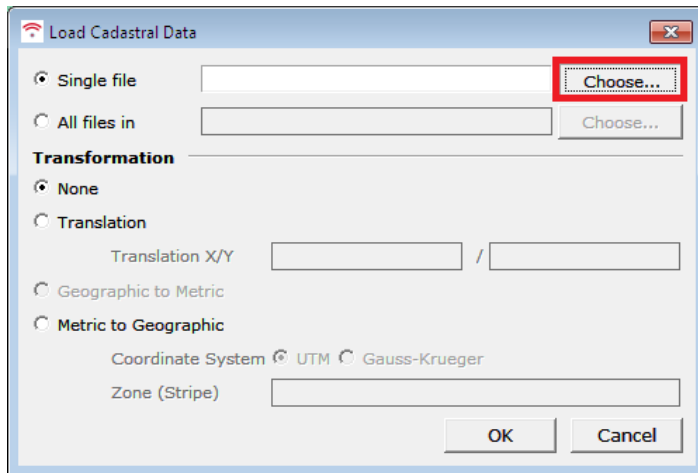


Figure 113: Choose a file

3. *Choose the transformation settings and click on **OK**.* Transformation need to be made according to the coordinate system used by the project. In most times a translation needs to be made because .dxf files do not hold specific location coordinates.

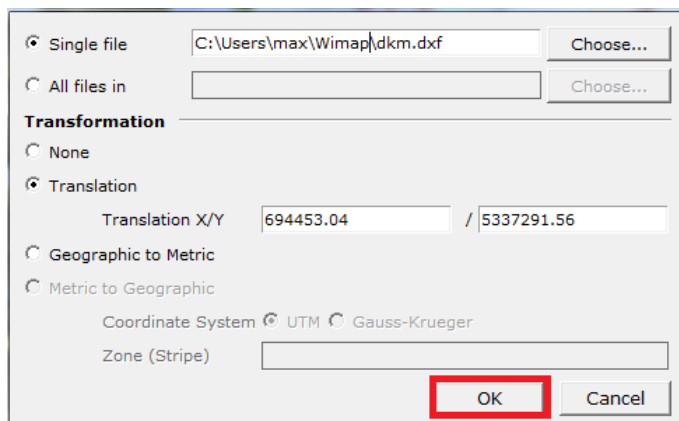


Figure 114: Add the cadastral data to the project

Subsequent a cadastral model appears at the specific place and additional layers appear at the project explorer. The number of layers differ in .dxf files depending on the specific data ordered by the land survey register.

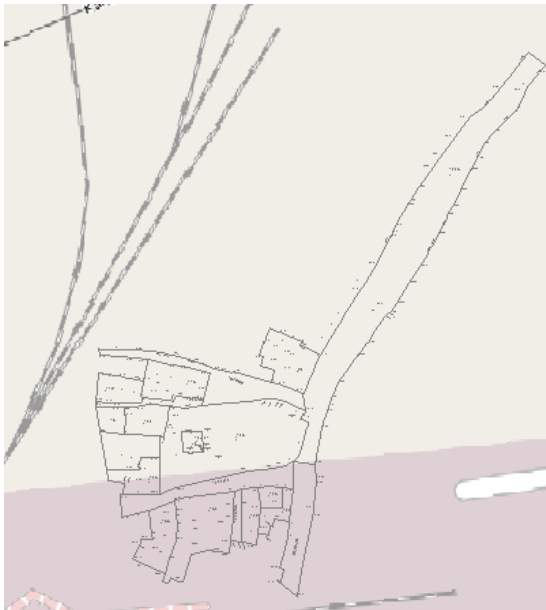


Figure 115: Unmodified cadastral data

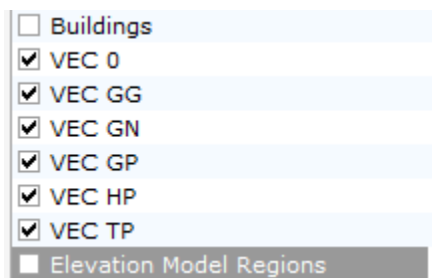


Figure 116: Additional cadastral layers

In this example there are six different layers available for the cadastral data. They include the 0-layer which is always available in cadastral data and some special layers like land name, land border or vegetation.

4.1.2 DXF Settings

The DXF settings can be found in **Project→Properties→DXF**. At the top it can be chosen whether .dxf files should be enabled or not. This is simply the same option as activating or deactivating the .dxf layers in the Project-Explorer. Below this option a scale of cadastral data can be set to a minimum or maximum value. Both values are set to maximum and minimum scale by default. With these values, the cadastral model can always be seen independently from the zoom factor.

At the bottom of the DXF settings the specific layers can be edited. Colours can be changed as well as priority of the specific layer or the visibility. If desired, layers can be deleted, too.

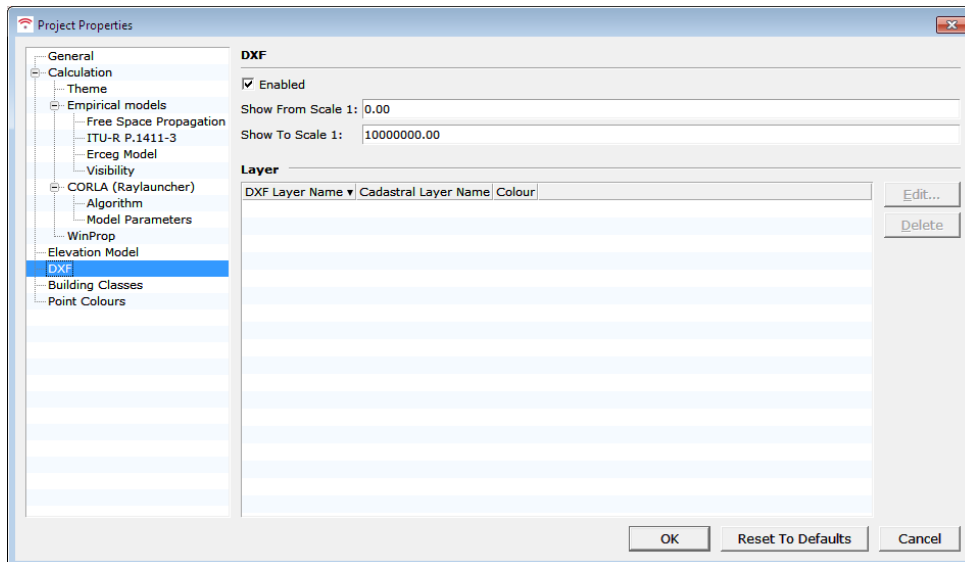


Figure 117: DXF settings



4.1.2.1 How to Edit Cadastral Data Layers

1. Open **Project** → **Properties** → **DXF**.

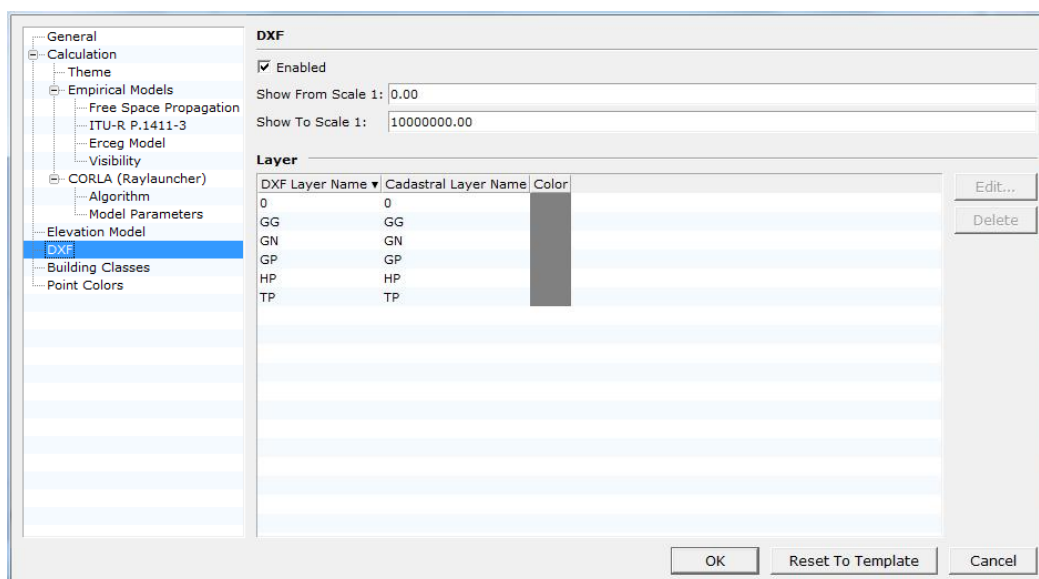
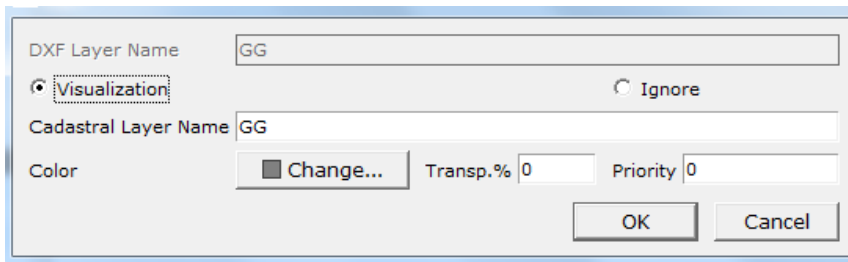


Figure 118: Edit cadastral data layers

2. At the bottom of the window, *double-click the desired layer or choose the layer and click on **Edit***. The layer configuration window appears.



DXF Layer Name: GG

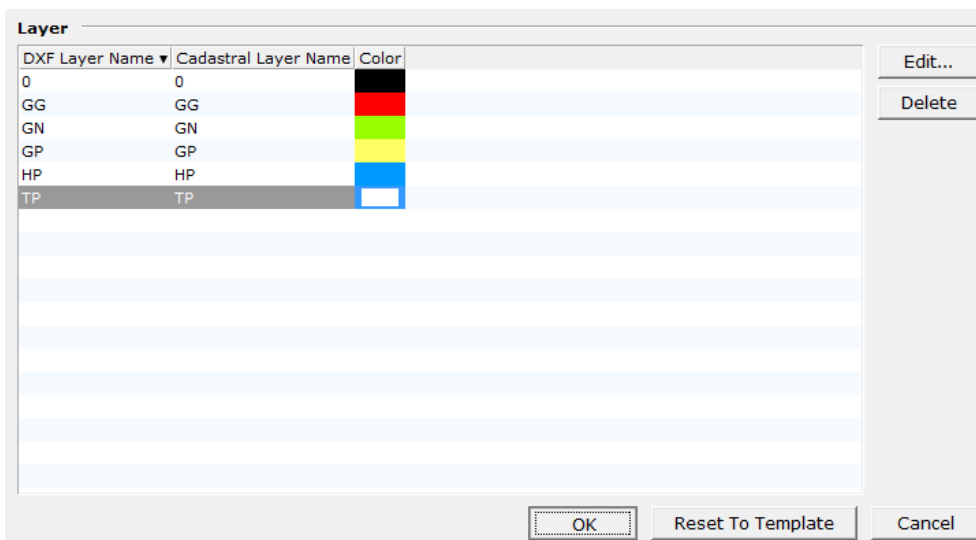
☒ Visualization ☐ Ignore

Cadastral Layer Name: GG

Color: Transp.%: 0 Priority: 0

Figure 119: Choose Visualisation or Ignore

3. *Decide whether a layer should be visible or not by choosing **Visualisation** or **Ignore**.*
4. *Rename the layer.* This is useful to keep track if there are many layers.
5. *Change the **colour**, **transparency** and **priority** of the layer.* Priority can be set between 0 and 1.000. Layers with higher priority always crossfade layers with lower priority.
*Click on **OK**.*



DXF Layer Name	Cadastral Layer Name	Color
0	0	
GG	GG	
GN	GN	
GP	GP	
HP	HP	
TP	TP	

Figure 120: Edited cadastral layers

6. If everything went well, the cadastral model should have changed colours.

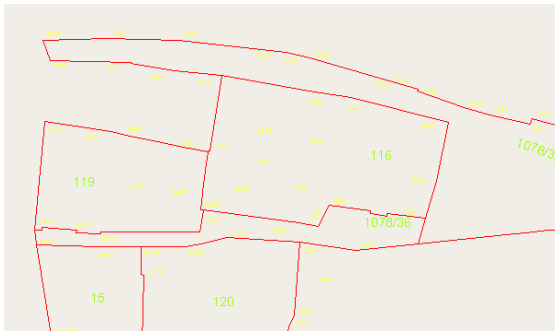


Figure 121: Cadastral data changed colour

In the **cadastral data tab** of the **Project-Explorer**, the cadastral data can be deleted from the project.

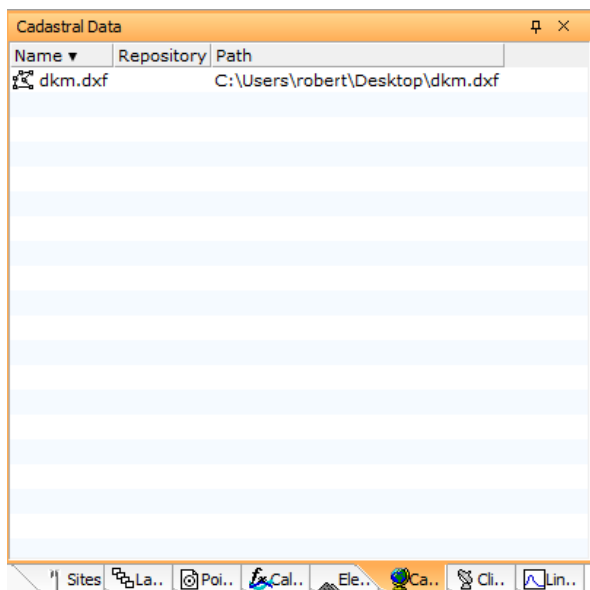


Figure 122: The Cadastral Data tab

4.2 Elevation Models

Elevation models are a basic feature of WiMAP-4G. They are essential in a project. They should ideally be imported when creating a preconfigured project. Elevation models are needed for proper use of the Terrain-Profiler and propagation model calculations. They will always be more efficient if an elevation model is available. Elevation models show the heights of every point in the selected area within the Terrain-Profiler. A manual import is hypothetically possible but the .asc or .asg file format which is required is not available on the free market.



4.2.1 How to Import an Elevation Model

1. Open **Geodata** → **Elevation Model** → **Load From File**.

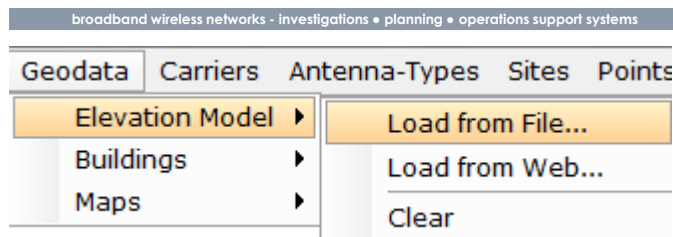


Figure 123: Load an elevation model

2. Choose **File** and click on **OK** to import the elevation model.

If the **elevation model** was imported successfully, it should be shown in the elevation tab of the Project-Explorer.

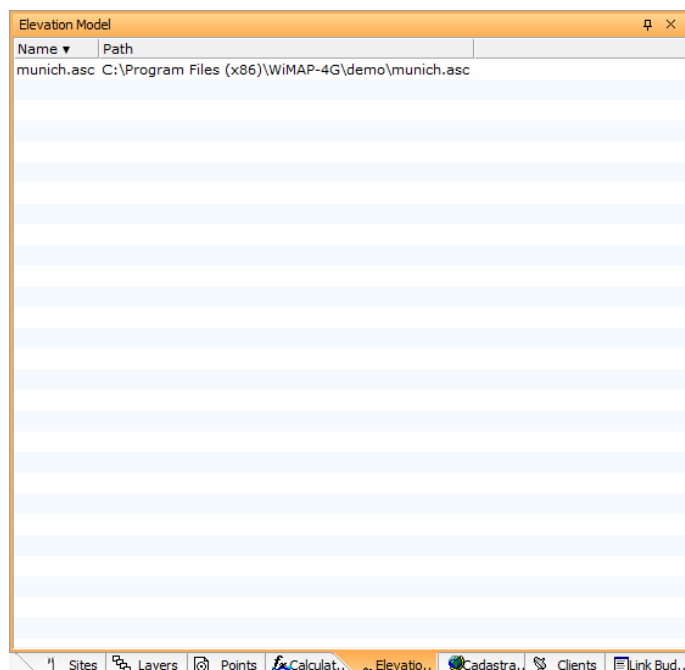


Figure 124: The elevation model tab after importing elevation models

4.2.2 How to Reload an Elevation Model from Web



1. Choose **Geodata**→**Elevation Model**→**Load from Web**.

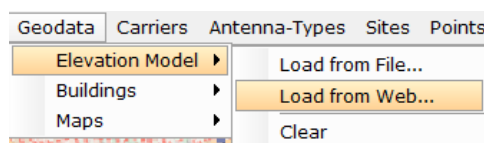


Figure 125: Reload elevation model from web

The current elevation model will be replaced by the new one.

2. Choose **Replace** to delete the old elevation model.

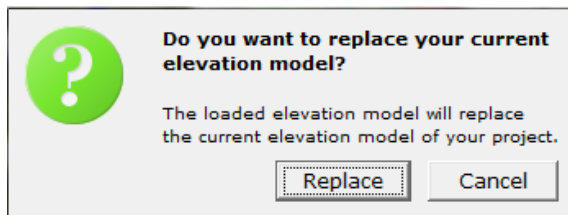


Figure 126: Replace the current elevation model

3. Choose the **Radius** for the new elevation model and decide whether the missing SRTM values should be added or not.

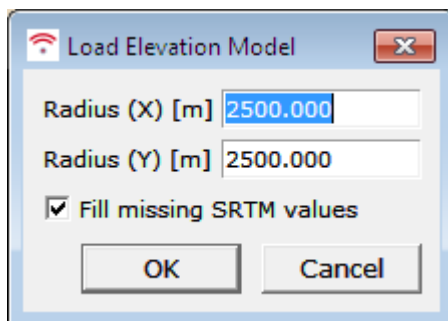


Figure 127: Choose Radius for the new model

Click on **OK** to load the elevation model.

WiMAP-4G will automatically replace the old one.

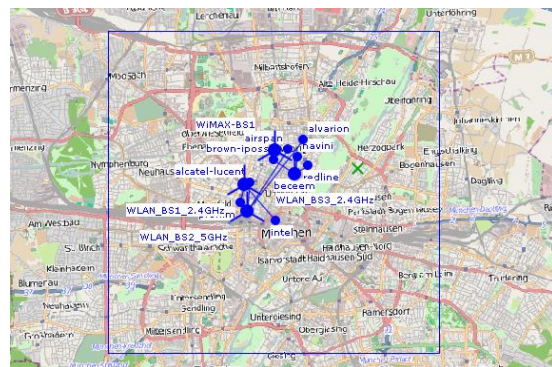
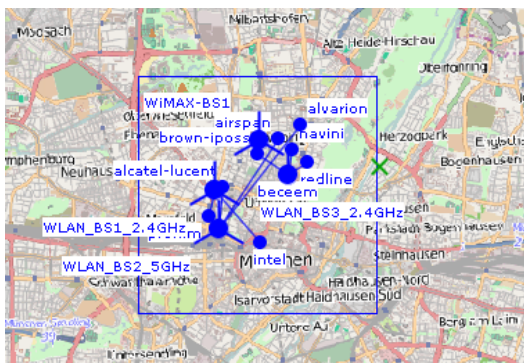


Figure 128: The new model will replace the old one

4.3 Background Images

The next object that can be imported is a background image. After creating an empty project a background image can be downloaded manually using Oneearth or other providers of satellite images. Format can be .tif, .tiff, .gif or .png.



4.3.1 How to Import a Background Image

1. Open **Geodata**→**Maps**→**Load Background Image**.

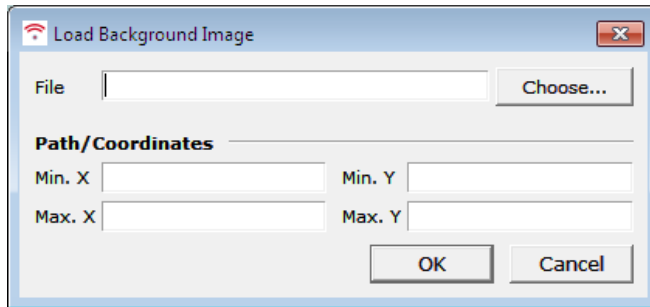


Figure 129: The import dialogue for a background image

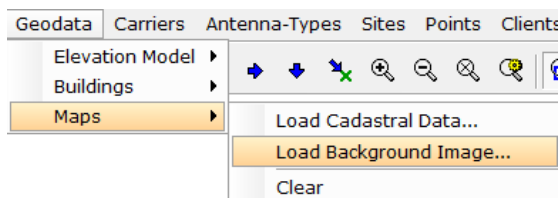


Figure 130: Load a background image.

2. Choose a file with **Choose** or enter a **File** path.
3. Enter the coordinates where the image should be placed at and click **OK**.
The Min. X and Min. Y coordinates are found in the lower left corner. The Max. X is the coordinate in the upper left corner.

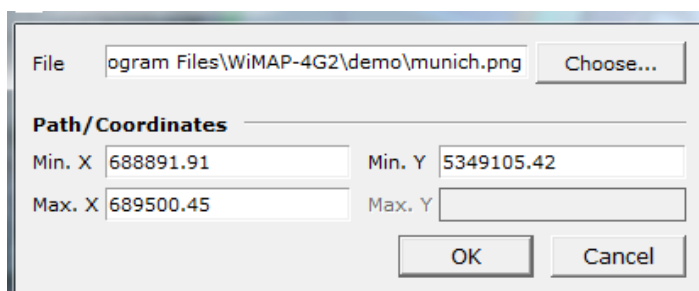


Figure 131: Fill in all fields and click OK

4.4 Location Images

The location images are georeferenced images that contain coordinate information. They can easily be imported in WiMAP-4G and viewed there. WiMAP-4G supports the import of location

images as .jpeg. It is possible to browse and to rotate through multiple images from one location while watching.



4.4.1 How to Import a Location Image/Images

1. Select **Geodata**→**Images**→**Import**

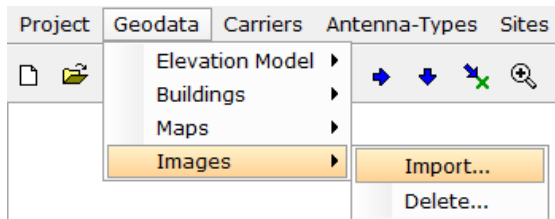


Figure 132: Import of location images

2. Enter **Layer Name**, choose **One File** and set a **File path**.

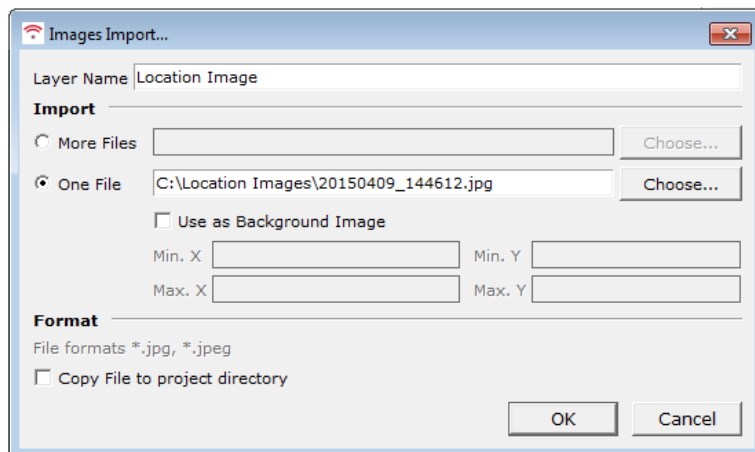


Figure 133: Import of one file

3. For importing more than one file: Enter **Layer Name**, choose **More Files** and then enter a **Directory path**.

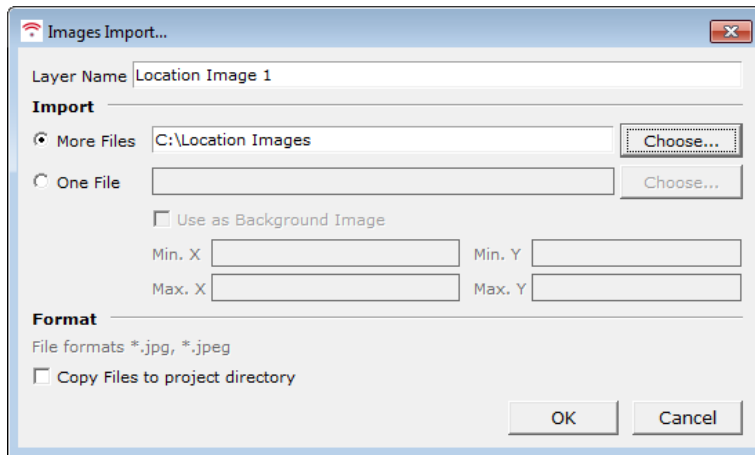


Figure 134: Import of more than one file

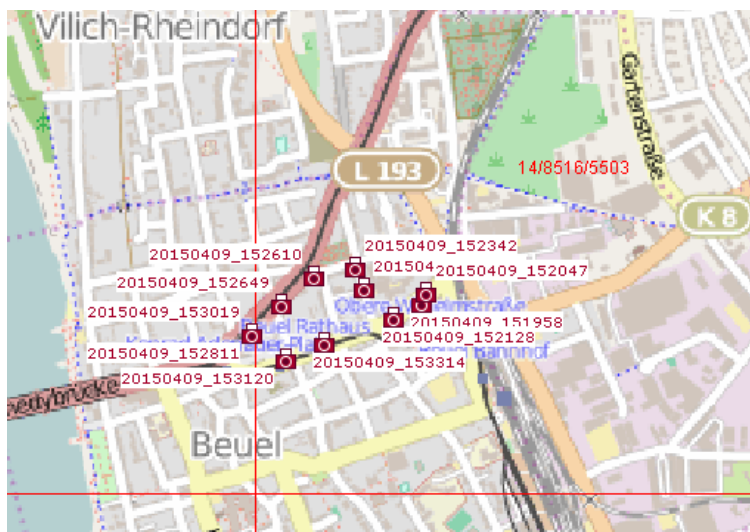


Figure 135: Imported location images are shown on the map



4.4.2 How to View a Location Image/Images

1. Right-click the desired location image on the map and click on **Show**.

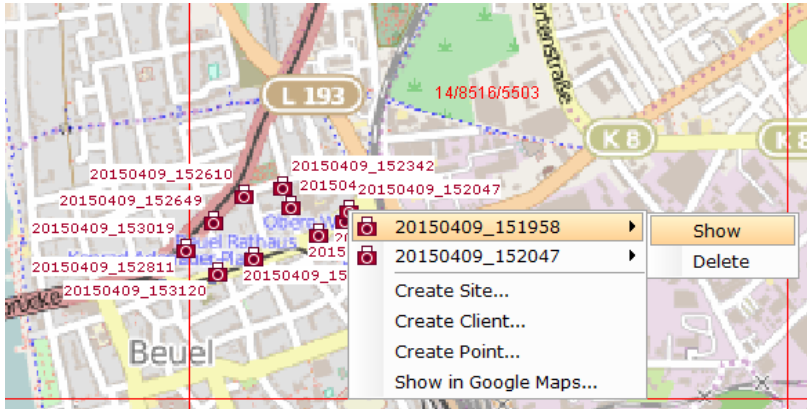


Figure 136: Show a location image

2. Click **Prev** or **Next** button to browse the images or click **Rotate Counterclockwise** or **Rotate Clockwise** button to rotate them.

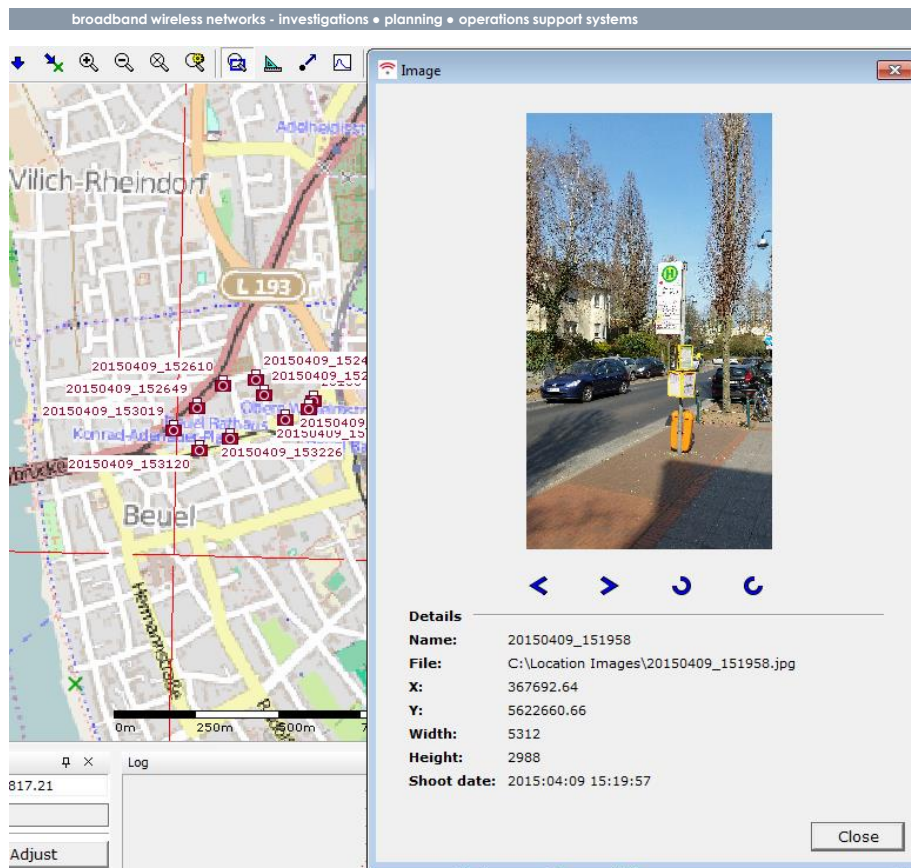


Figure 137: Browse or rotate location images



4.4.3 How to Delete a Location Image/Images

1. Select **Geodata**→**Images**→**Delete**

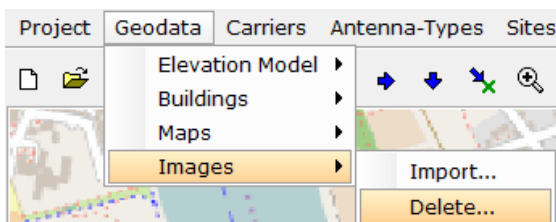


Figure 138: Delete location images from menu

2. Choose the desired layer of location images and click **OK**.

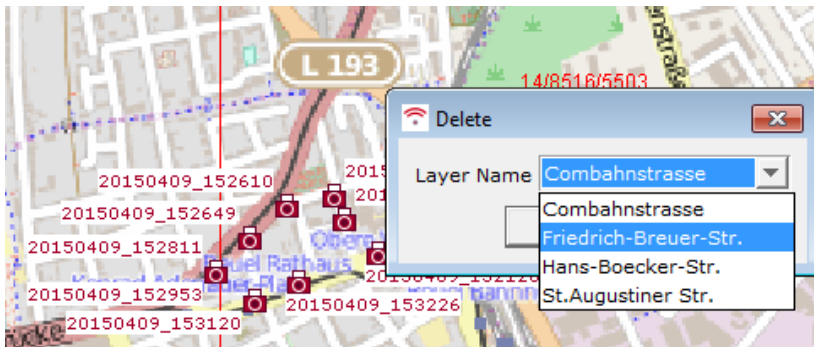


Figure 139: Choosing the image layer

3. As an alternative *right-click the desired location image on the map and click on **Delete**.*

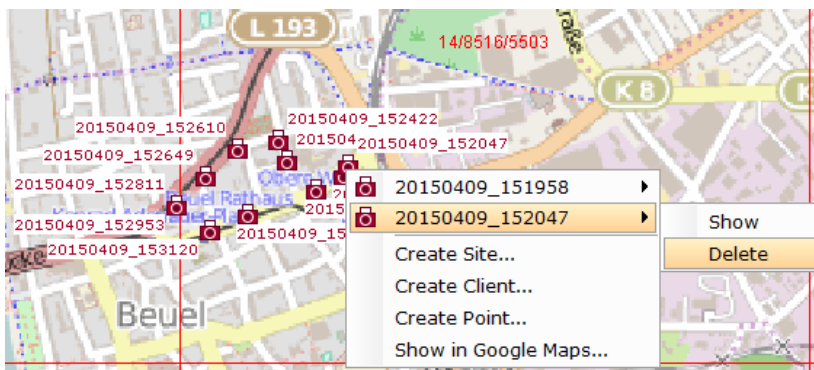


Figure 140: Delete location image from context menu



4.4.4 How to Import as Background Image

1. Select **Geodata→Images→Import**

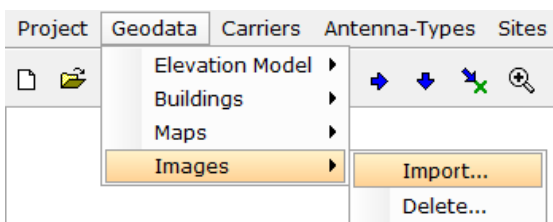


Figure 141: Import of location images

2. Choose the desired file and activate option **Use as Background Image**. Set coordinates to locate the image.

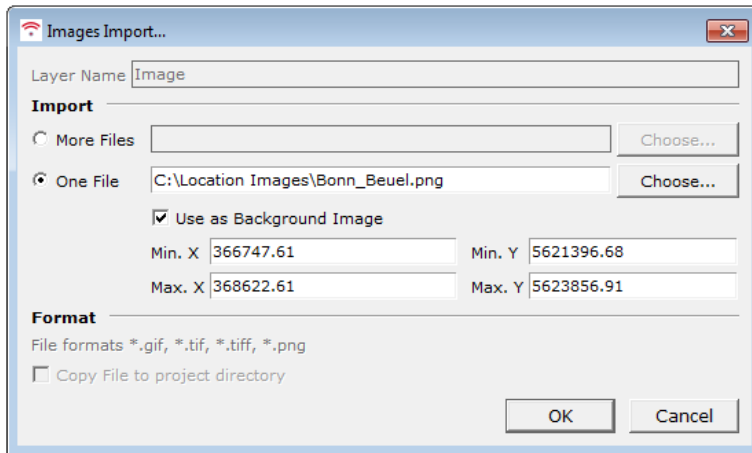


Figure 142: The import as background image

3. *Follow the steps described above (like in 4.3.1).*

5 Buildings

Buildings and wood are structures needed for detailed calculations. Creating and/or importing those structures is necessary to achieve exact calculations. Every calculation is nearly useless if buildings and/or wood have not been included. There are different methods to create or import these structures - they are explained in this chapter.

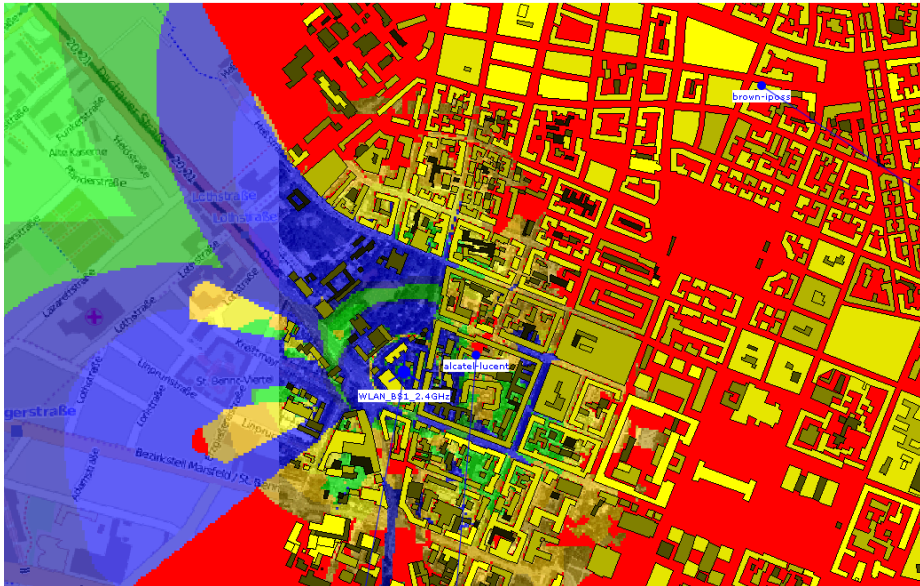


Figure 143: ITU-R P.1411-3 field strength calculation including buildings

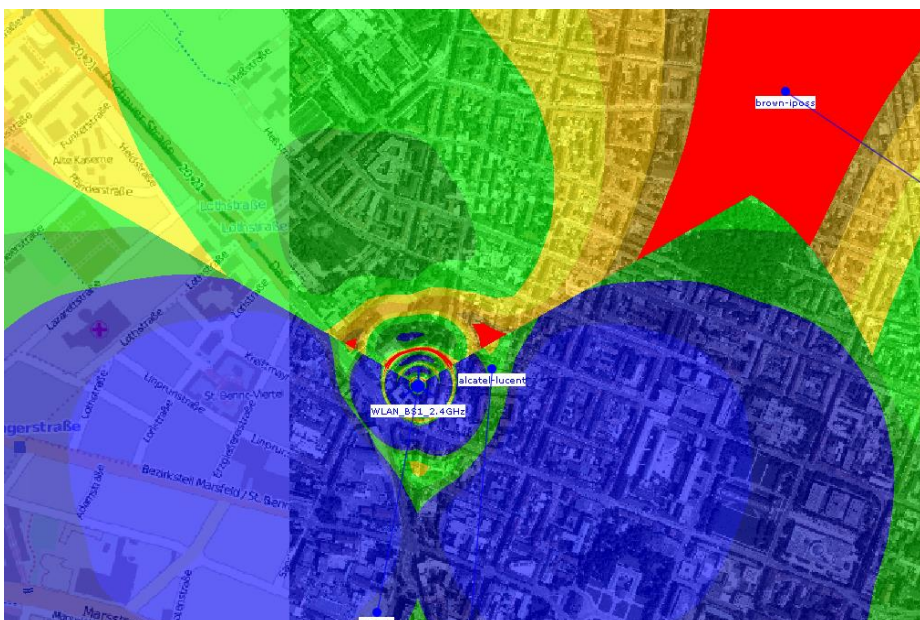


Figure 144: ITU-R P.1411-3 field strength calculation without buildings

5.1 Create Buildings

Create buildings is a matter of importance but it is not as easy as some users may think. For a proper creation of structures the correct coordinates, length and height should be known. Create buildings, where there are no actual buildings, or shift buildings a few meters away due to incorrect coordinates, can doom a project to failure. Shifting may cause bad results which makes it hard to realize the project. In the last resort a project seems to work in the program but in reality there are big field strength problems.



This section refers to buildings, but wood can be imported in the very same way.



Buildings should be created to the best of ones knowledge to eliminate possibility of future problems.



5.1.1 How to Create Buildings

1. Open **Geodata**→**Buildings**→**Capture**.

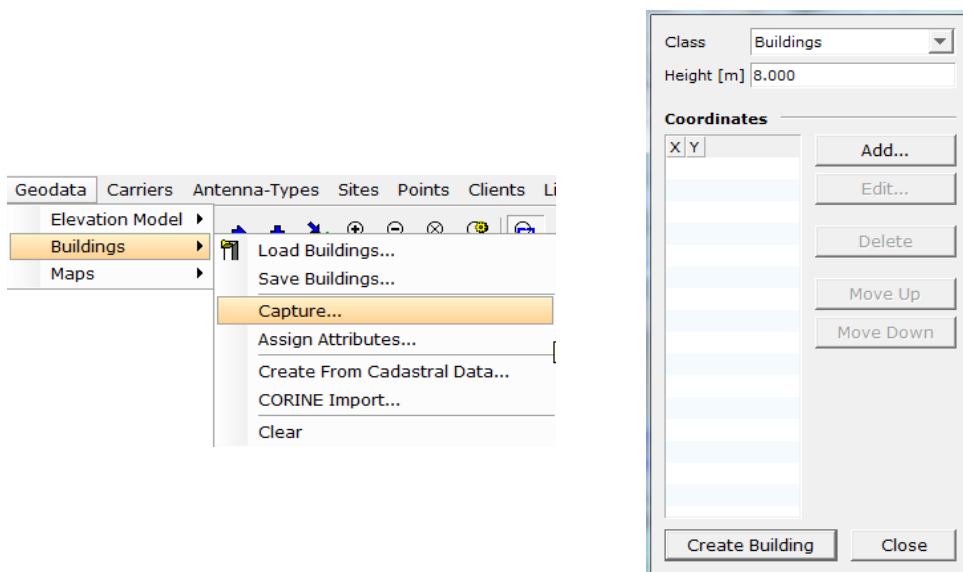


Figure 145: Capture buildings

2. There are two ways to create buildings or wood:
 - For the exact but slow method watch a-d.
 - For the fast method watch e-f.

- a. Add buildings by entering the exact coordinates: This is for sure the more precise method to create buildings but therefore it is more time-consuming. Click **Add** and enter the building coordinates. These have to be the coordinates of the building corners. For example a rectangular building needs four coordinates whereas a roundel needs much more depending on the precision that should be reached.



The first and the last coordinates connect each other automatically. That is why there are only four coordinates for example for a rectangular building instead of five.

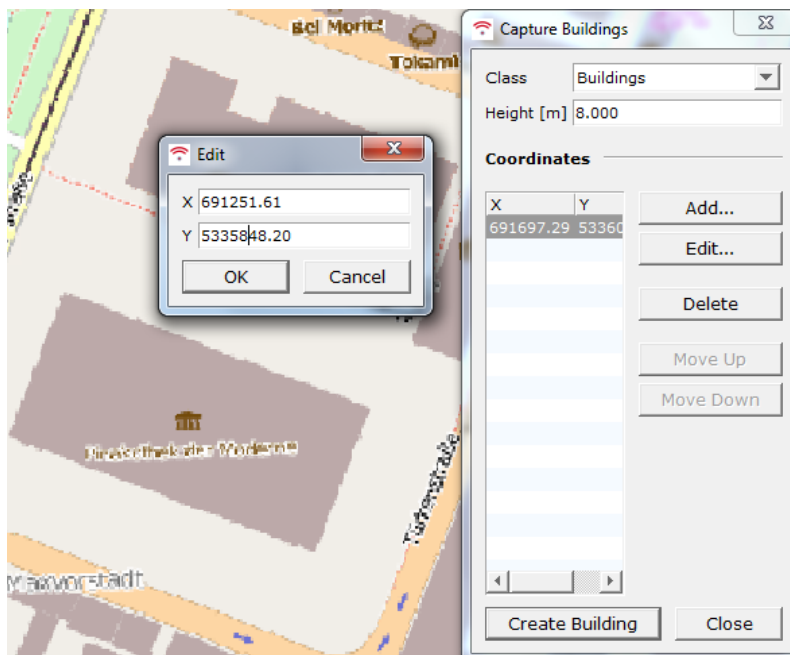


Figure 146: Add the first coordinates.

- b. Click **OK** to set the first coordinates.
A blue dot should appear to show the entered coordinates.

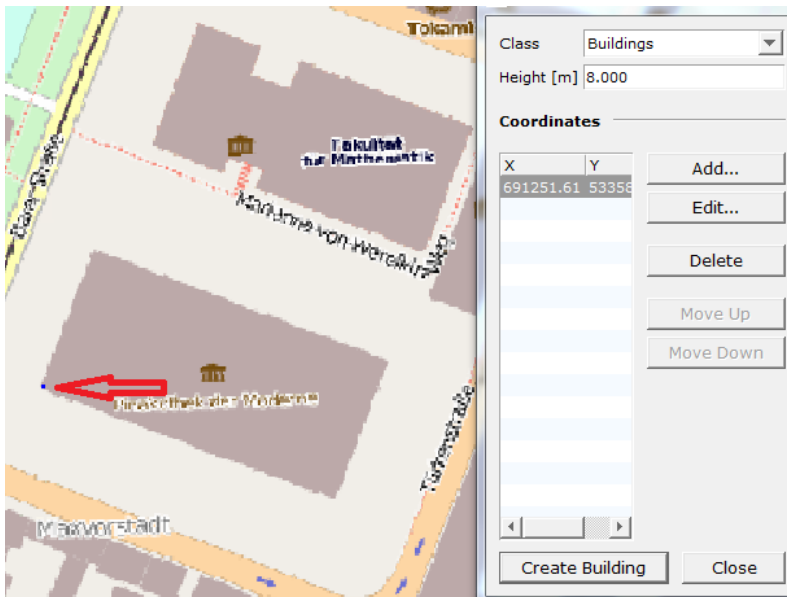


Figure 147: The blue dot shows the coordinates.

- c. Add more coordinates depending on the building type.



Note, that the coordinate order should be consistent. The order can be modified afterwards by clicking on the specific coordinate pair, hold the mouse button and shift the coordinates to the desired position.

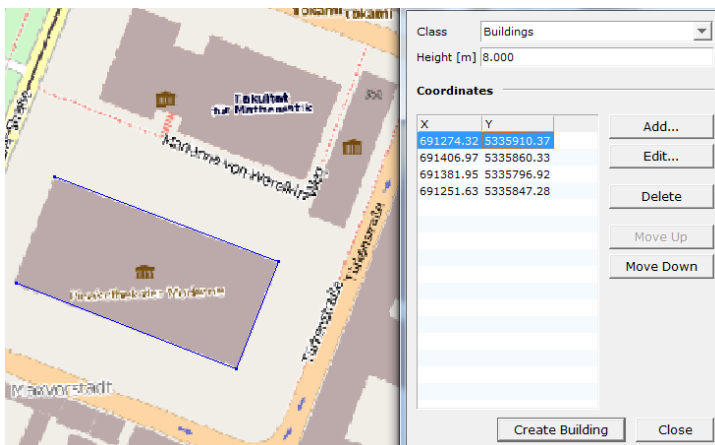


Figure 148: All coordinates added

After all coordinates have been entered there should be blue lines which border the building.

- d. Make sure to apply the right height for the building.
Click on **Create Building**.

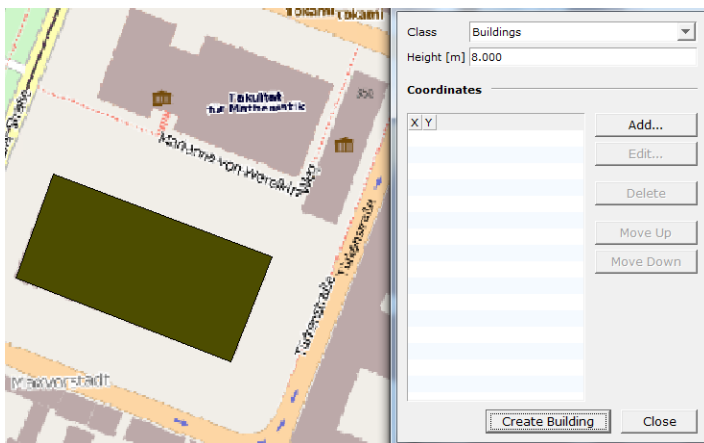


Figure 149: A created building

- e. Add buildings with drag and drop: This is the fast method. It can also be precise if it is done correctly. OpenStreetMap™ offers the exact coordinates for a specific environment. *Simply click on the corners of buildings in the exact order* to connect the points automatically.

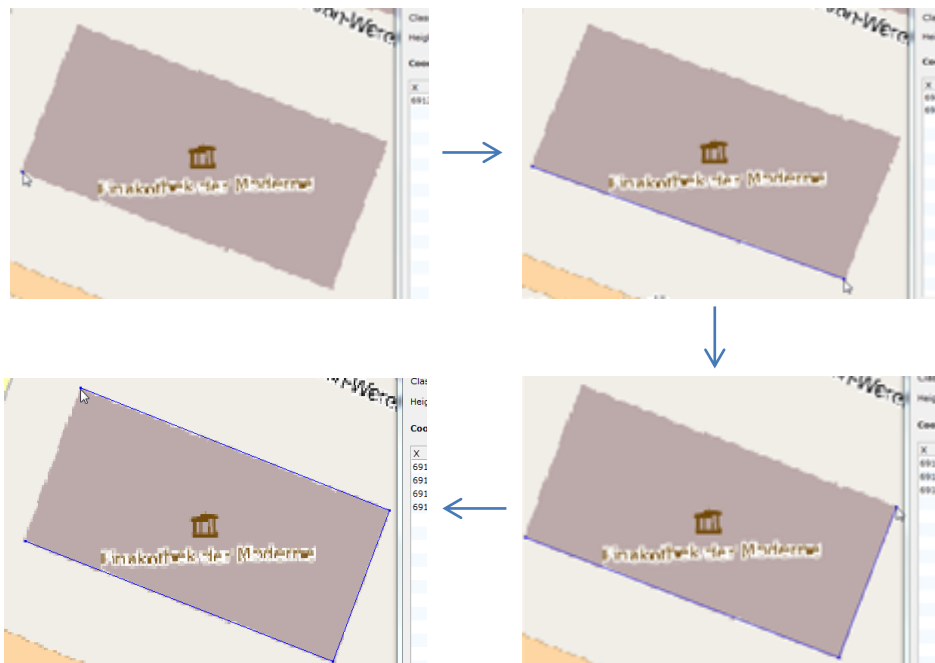


Figure 150: Add all corners

- f. After all coordinates have been captured, make sure to apply the right height for the building.
*Click on **Create Building**.*



Figure 151: Building added via drag and drop

5.1.2 Advanced Buildings

As many users realize in a project, there is more than just create a building. Maybe there are buildings with a courtyard or something similar.



5.1.2.1 How to Create Courtyard or Similar in Buildings

1. Open **Geodata** → **Buildings** → **Capture**.
2. Choose the *building class* that is used for the building wanted to edit.
3. Simply add the coordinates of the courtyard or drag and drop it.

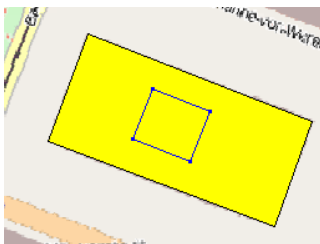


Figure 152: Add the courtyard

4. Click **Create Building**.

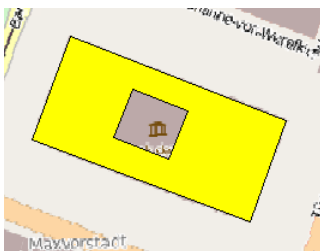


Figure 153: Courtyard

Sometimes there are buildings inside other buildings, buildings intersect other buildings or even there are towers on the roof of buildings. These buildings cannot be created without making a few arrangements.

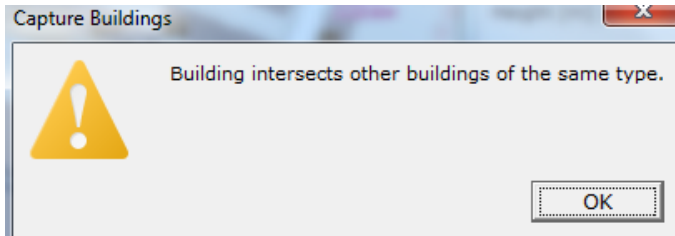


Figure 154: Intersecting buildings of the same type is not possible

Each building has a type id. The problem is that buildings with the same type id cannot intersect. As mentioned in chapter 3.1.5 there are building classes which need to be created for intersection. For bigger projects many building classes are needed as well as many wood classes.

ID ▼	Name	Indoor Loss	Attenuation	Color From	Color To	
0	Standard_Building	Yes	10.00 + 0.00 * length[m]	100.000		Add...
1	Broadleaf_Forest	Yes	10.00 + 0.00 * length[m]	100.000		Edit...
2	Mixed_Forest	Yes	10.00 + 0.00 * length[m]	100.000		
3	Coniferous_Forest	Yes	10.00 + 0.00 * length[m]	100.000		Delete
4	Tower	Yes	10.00 + 0.00 * length[m]	100.000		
5	Inside_Building	Yes	10.00 + 0.00 * length[m]	100.000		Attenuations...
6	Intersecting_Building	Yes	10.00 + 0.00 * length[m]	100.000		Colors...

Figure 155: Building classes

These building classes are available in the capture building dialogue. They can be used to create nested buildings or woods.

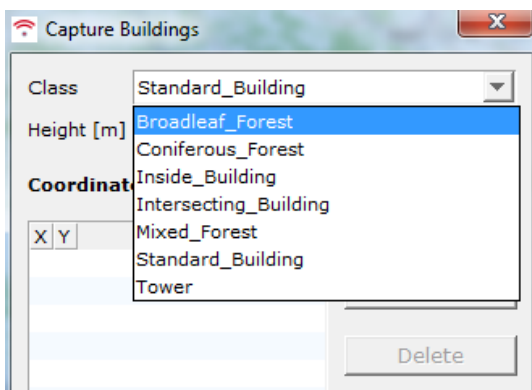


Figure 156: Capture buildings



5.1.2.2 How to Add Intersecting Buildings

Assuming that more building classes has been added.

1. Open **Geodata**→**Buildings**→**Capture**.
2. Create a building as described in 5.1.1.



Figure 157: A new building

3. Choose other building classes, for example a tower, and build it inside the first building.

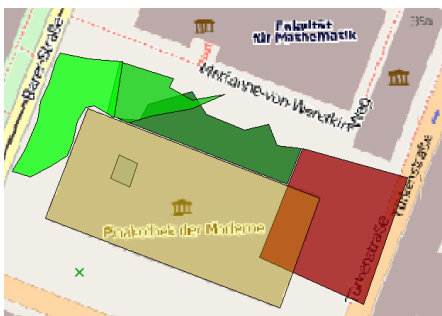


Figure 158: Intersecting buildings and wood

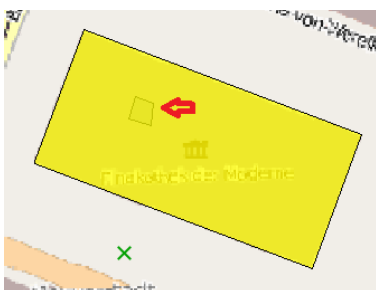


Figure 159: Building in a building

A tower has been created and placed inside the other building without any error or warning message.



To make buildings inside other buildings clearly visible, just make a few visibility adjustments in the building classes settings.

5.2 Edit Buildings

The building size can be changed as well. Please keep in mind that building needs at least three coordinates.



5.2.1 How to Edit a Building

1. Take a right click on an existing building and select **Edit Building...** and the **Edit Building** window will be opened.

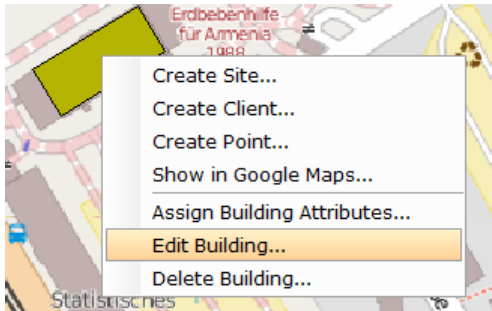


Figure 160: Context menu of a building

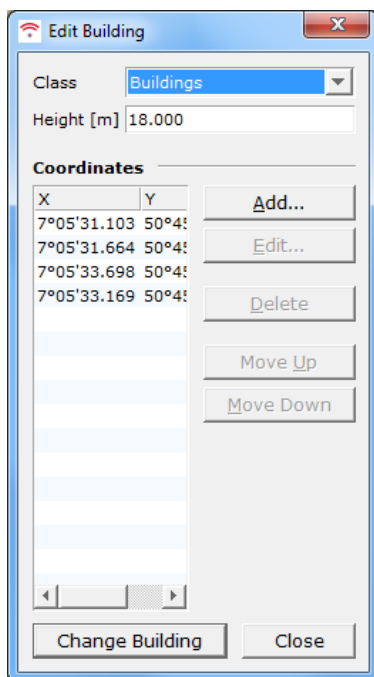


Figure 161: Edit building window

2. After changing, click on **Change Building** to save the changes.

5.3 Export Buildings

Buildings can be exported from WiMAP-4G to import buildings to other programs or to WiMAP-4G itself for a different project.



5.3.1 How to Export Buildings

1. Choose **Geodata->Buildings->Save Buildings**.

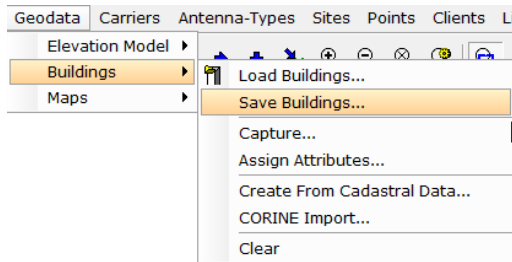


Figure 162: Choose Save Buildings to export buildings

2. Choose a directory, pick a desired name for the export file and click on **OK**
After exporting the .mif file can be found in the chosen save directory.

5.4 Import Buildings

Buildings can be imported as easy as they can be exported. The files have to be .mif files.



5.4.1 How to Import Buildings

1. Choose **Geodata->Buildings->Load Buildings**.

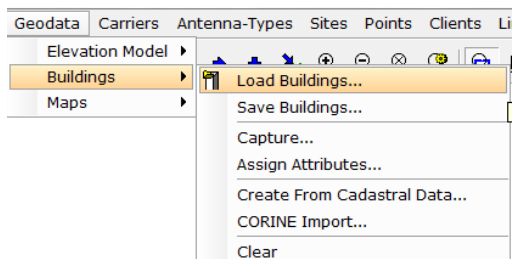


Figure 163: Choose Load Buildings to import buildings

2. Choose the desired .mif file and click **OK**.

All buildings included in the .mif file has been imported now and can be edited and/or deleted as usual.

5.5 Create Buildings Using Cadastral Data (Professional-Edition)

Buildings can be created using the **cadastral data**. This is an advanced feature and therefore only available for Professional-Edition customers. Only the cadastral data is needed which can be purchased at the local land survey register. Import buildings with cadastral data is more precise than creating them, because the cadastral data is a professional product made by engineers. OpenStreetMap™, which is mostly used to get an impression where to create buildings, is an open project and therefore not immune against individual caused errors.



5.5.1 How to Create Buildings Using Cadastral Data

Assuming, that cadastral data has been loaded and contains a building layer.

1. Choose **Geodata**→**Buildings**→**Create from Cadastral Data**.

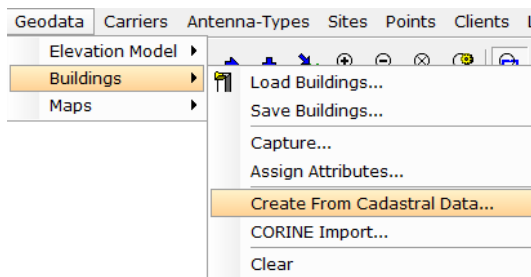


Figure 164: Create buildings from cadastral data

2. Choose the layer that contains the structures in the appearing window. Choose the structure depending on the available **building classes**. The last important information is the structure height. The height of 8 m is default and should be used, if the user is not sure how high the buildings are.

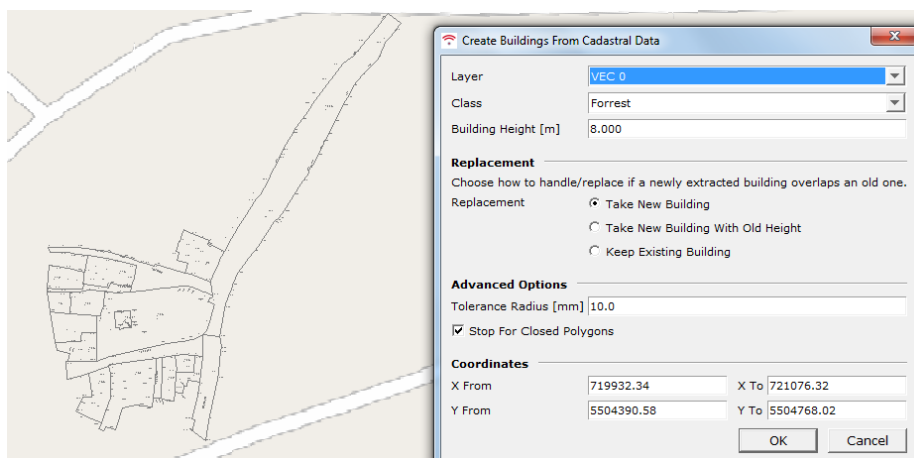


Figure 165: Import settings

3. There are advanced settings for imports, too. Decide what happens in case new buildings intersect old buildings, in the replacement options.

Replacement options:

- **Take new building:** Old buildings will be overwritten if new buildings intersect them.
- **Take new building with old height:** Old buildings will be overwritten by new but they keep their height.
- **Keep existing building:** Old buildings cannot be overwritten.

The exact coordinates of the cadastral data position is needed to place the buildings on the right position of the map.

*After filling in all the needed information, click on **OK** to create the buildings.*

All the buildings in the building layer are created.

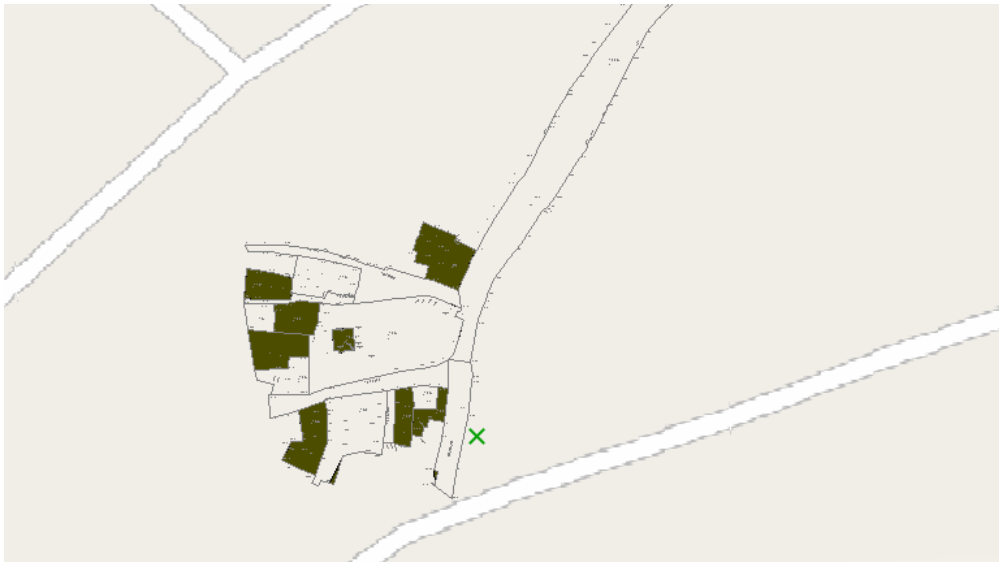


Figure 166: Buildings created from cadastral data

5.6 Create Buildings Using CORINE (Professional-Edition)

Creating buildings with **CORINE data** is a feature of the Professional-Edition. The CORINE Land Cover is a project established by the European Environment Agency to classify a computerized inventory of the land cover in European countries. Therefore, it is an optimal source for buildings, wood and other important objects needed by WiMAP-4G to create a proper calculation. CORINE data can be downloaded from the EEA-Website.



5.6.1 How to Create Buildings Using CORINE Data

1. Choose **Geodata**→**Buildings**→**CORINE Import**.

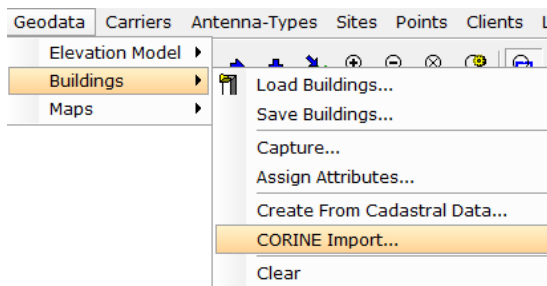


Figure 167: CORINE import

2. Choose a file, fill in the coordinates of the desired environment and click on **Next**.

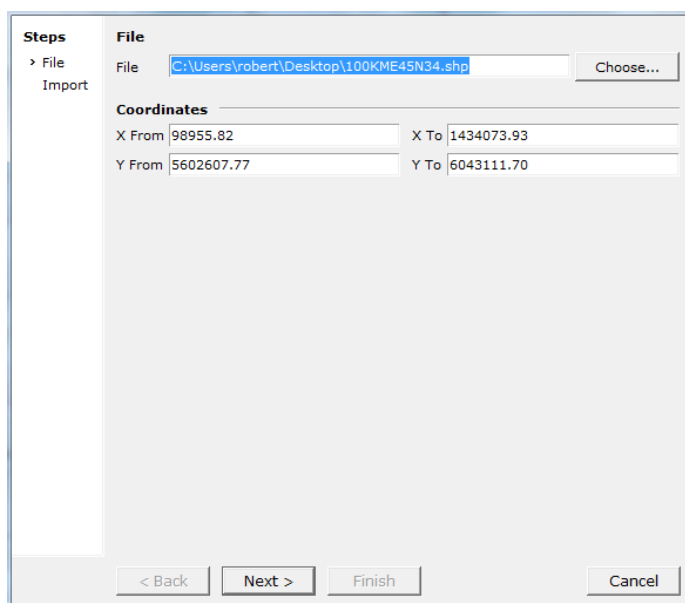


Figure 168: CORINE settings

3. After the environment details are loaded, the following window should appear:

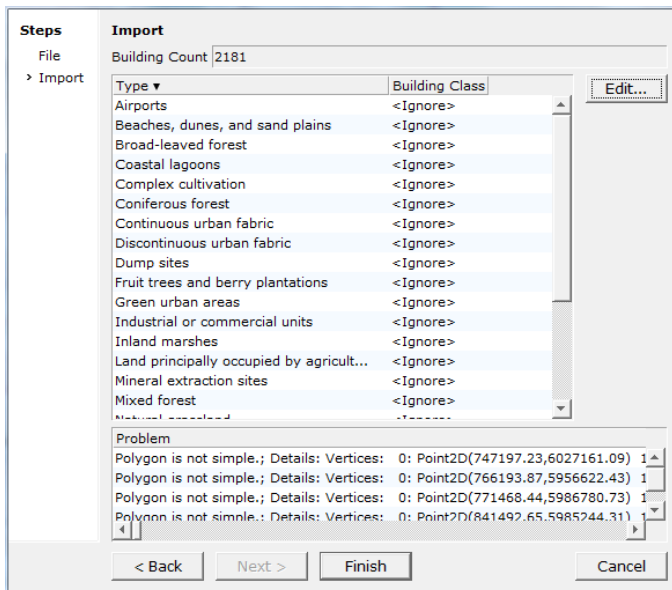


Figure 169: Imported structures

The building count shows the actual number of structures imported from the CORINE data file.

4. All structures are ignored by default because the user should choose by himself, which buildings he wishes to import.
*Simply double-click on the desired structure or select it and click on **Edit**.*

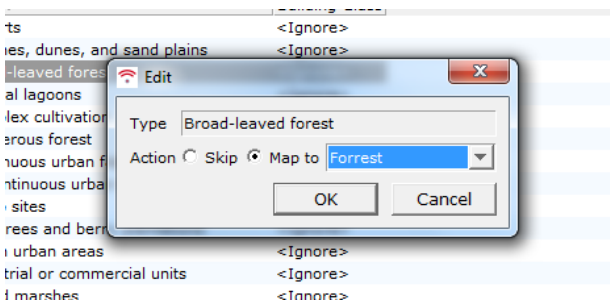


Figure 170: CORINE imports need to be mapped to a building class

*Set Action to **Map To** and select the corresponding structure.*



Additional structures can be added or edited in the WiMAP-4G settings. See chapter 3.1.5 for more information.

5. After mapping all desired structures to the corresponding building class, *click on **Finish***. The imported structures appear on the map.

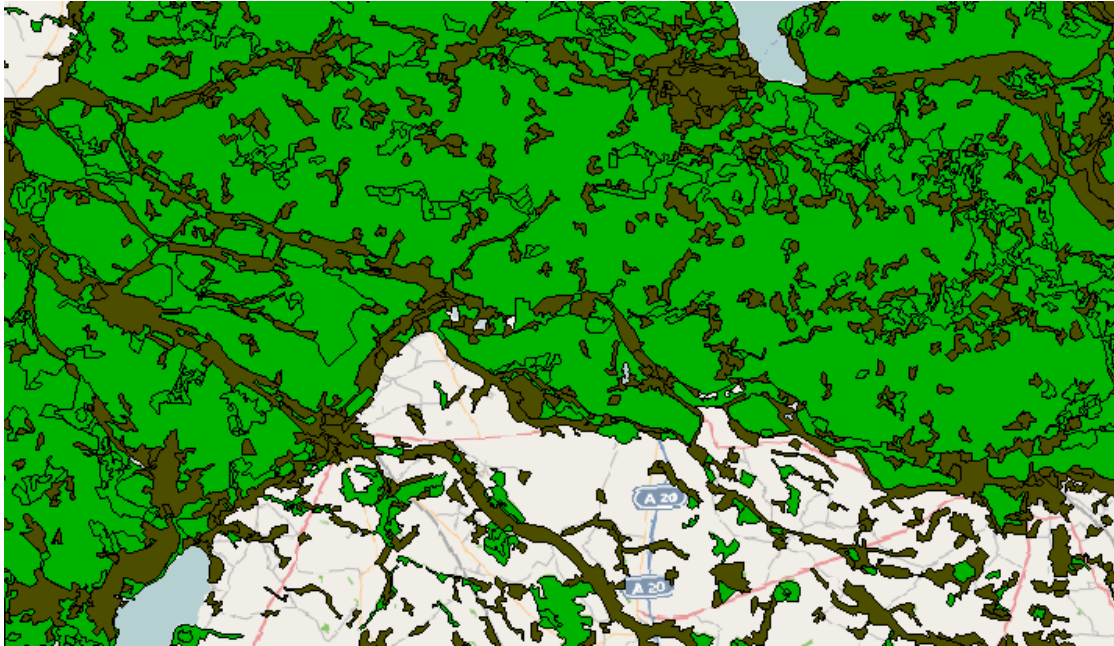


Figure 171: A whole region created with CORINE imports



Additional buildings can be added by loading the same CORINE file again.

5.7 Delete Buildings



5.7.1 How to Delete Building manually

1. Take a right click on the building which you want to delete and select in the context menu **Delete Building...**

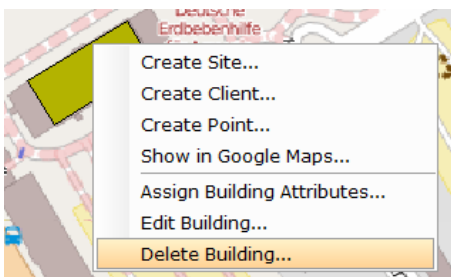


Figure 172: Context menu of a building

2. The building is deleted successfully.

5.8 Clear Building Cache

Clearing the building cache deletes all buildings from the project.

5.8.1 How to Clear Building Cache



1. Choose **Geodata**→**Buildings**→**Clear**.

All buildings will be deleted.

6 Carrier

Carriers are waveforms modulated with a specific input signal for the purpose of conveying information on the air-interface in the case of WiMAP-4G. The following carrier types are available and preconfigured in WiMAP-4G:

- **WLAN 2.4 GHz:**
 - 100 mW (10 mW) allowed transmission power, high availability and therefore lower costs for equipment
 - Sharing channels with other sites is expected
 - 13 (11) overlapping and/or 3 non-overlapping channels
 - 2.400-2.484 MHz spectrum
- **WLAN 5.0 GHz:**
 - 1.000 mW allowed transmission power outdoor, less used frequency band and therefore interference-free connection possible
 - In general, equipment needs to provide dynamic frequency selection and transmission power control. It is expensive compared to the 2.4 GHz technology.
 - 24 non-overlapping channels:
 - 8 indoor channels (200 mW power)
 - 11 outdoor channels (1 W power)
 - 5 FBWA (4 W power)
 - 5.180-5.870 MHz spectrum
- **WiMAX** (Worldwide Interoperability for Microwave Access):
 - Microwave signals for connection range up to 50 km therefore suitable for poorly accessible regions
 - Comparable to WLAN except the range is much higher
 - 3.400-3.700 MHz spectrum
- **Backhaul:**
 - Connection between core network and small sub networks
 - Point to point and/or point to multipoint radio relay
 - Frequency spectrum different, up to 38.5 GHz
- **Tetra** (terrestrial trunked radio, also known as Trans European Trunked Radio Access):
 - Designed for use by government agencies, emergency services and military
 - Low frequency spectrum and therefore huge range with high coverage

- Expensive and can interfere other sensible electronic devices like TV receiver
- 380-470 MHz spectrum
- **Generic OFDM** (Orthogonal Frequency Division Multiplex):
 - High efficiency caused by nearly constant spectral power density
 - Tough against interference
 - Needs exact time and frequency synchronization
 - 470-870 MHz spectrum



6.1 How to Create or Edit Carrier

1. Choose **Carriers** → **Edit**.

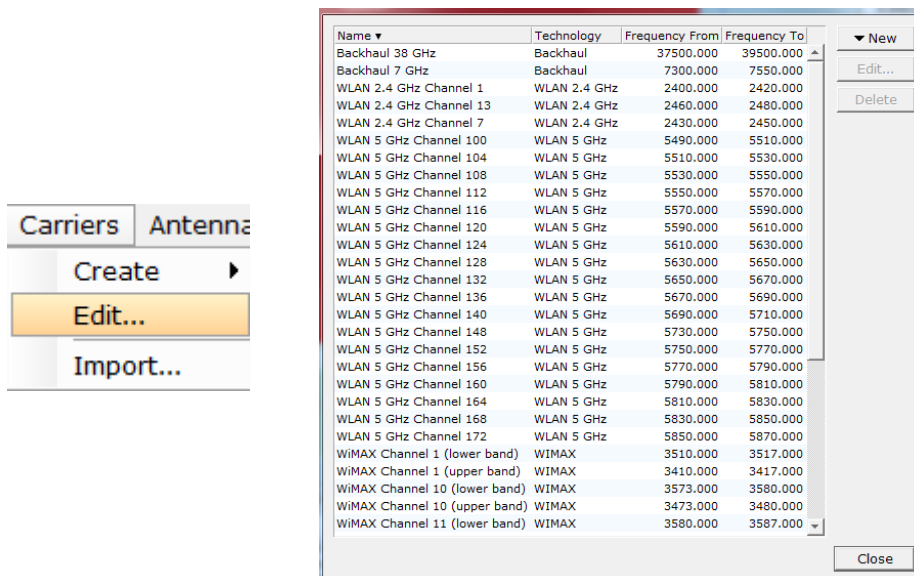


Figure 173: Click Edit to show a list of all carriers

2. To create a new *carrier* click **New** and select the desired carrier type. To edit a carrier type, double-click it or choose it and click on **Edit**. A carrier can be deleted by selecting it and click **Delete**.

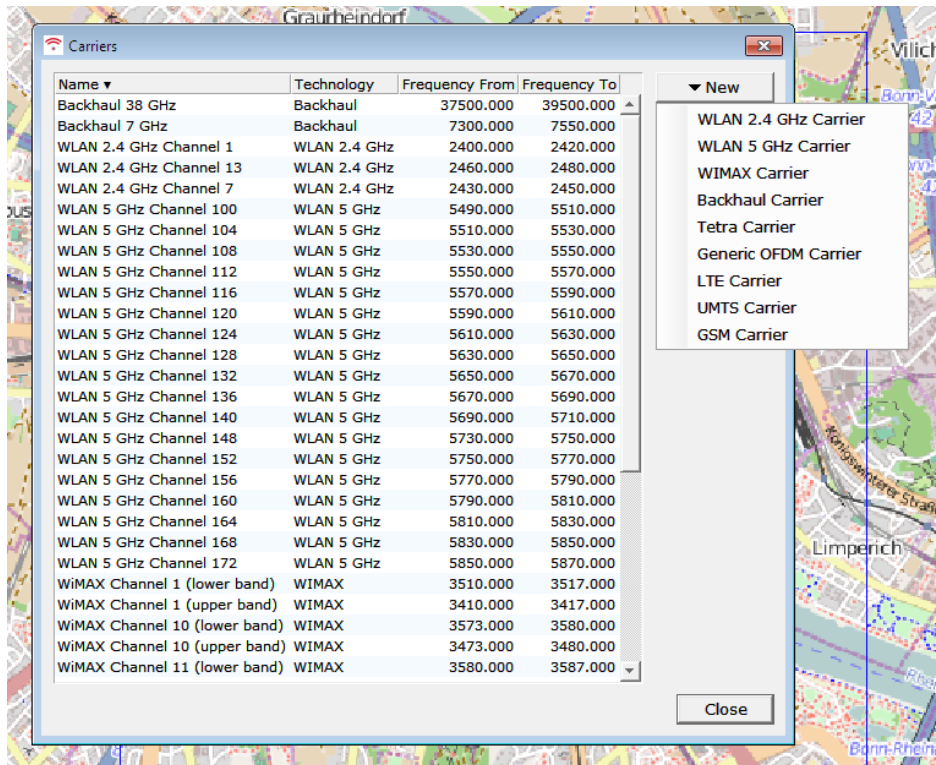


Figure 174: Choose New to create a new carrier

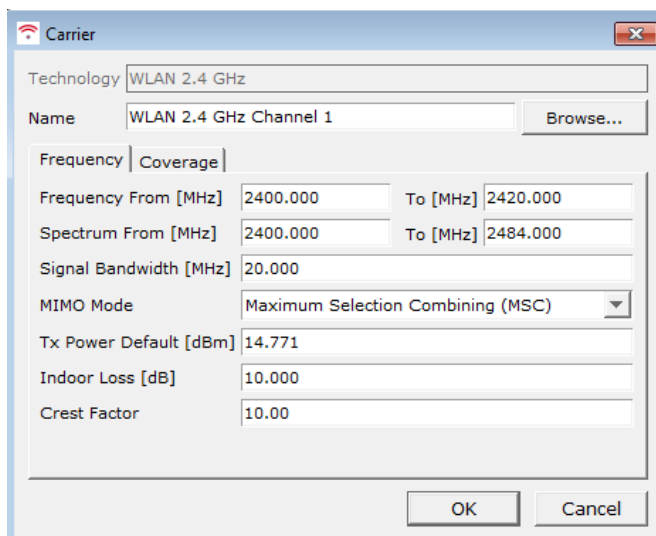


Figure 175: The Carrier Settings window

A carrier can be created by *choosing **Carriers**→**Create***, too.

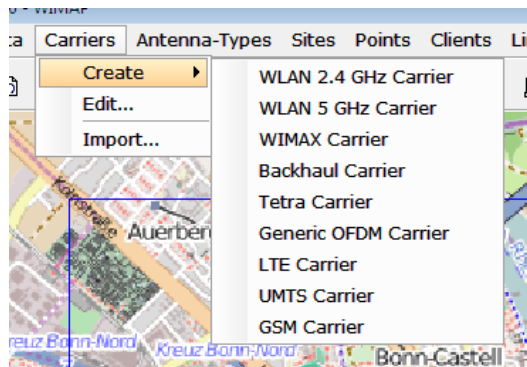


Figure 176: The fast way to create a carrier

3. *Configure the carrier* and always keep the specifications for the specific carrier in mind. A 2.4 GHz WLAN should not have a frequency spectrum up to 5 GHz.

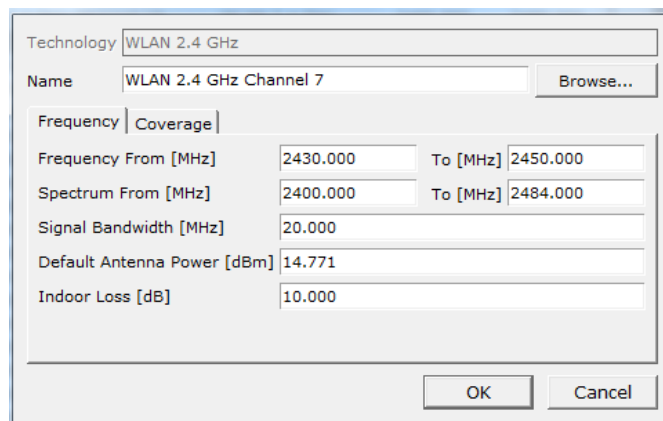


Figure 177: Configured carrier

4. Click **Coverage** and edit the coverage options according to the chosen carrier type.

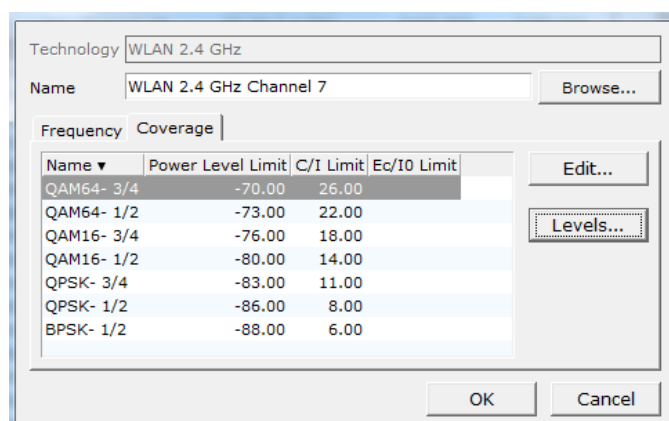


Figure 178: Coverage settings

Coverage is preconfigured for every carrier type but the specific values can be changed by clicking **Edit**. Colour options can be changed by clicking on **Levels**. To add a new value, a

level needs to be created first. Click **Levels→Add**, add the specific values and click on **OK**. Now the parameters of this new value can be set with **Edit**.

5. If all necessary carriers have been created or edited, click on **OK**.

6.2 Import Carrier

Importing carrier is possible with WiMAP-4G. Both, importing carrier information from other projects to the active working set and importing carrier data from other programs that allow exporting data in .rad format is provided. This feature can be useful to import carriers for the specific country and restrictions of this country. Carriers used in European projects and also the program defaults may be useless in other country for example in America. With this feature the American carriers can be imported and do not need to be created for every project.

6.2.1 How to Import Carrier

1. Choose **Carriers→Import**.

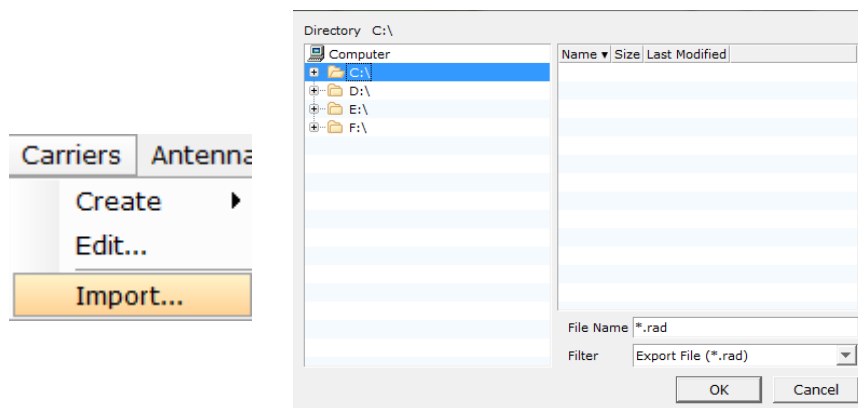


Figure 179: Import carriers

2. Choose the .rad file that holds the new carriers and click on **OK** to import these carriers. If everything worked out successful, the log shows the following information and the imported carriers are available now.

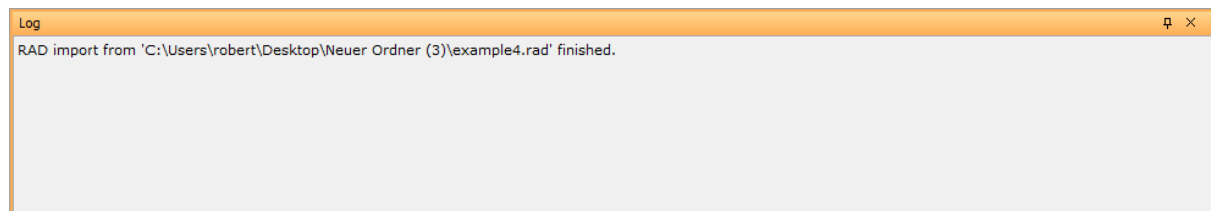


Figure 180: Log information for the current import

Existing carrier will not be replaced. Instead of replacing the log shows the following information:

Object WLAN 5 GHz Channel 156 (UUID=ea912e95-3251-440e-83c6-f1ec4efc4e5a) already exists and has not been replaced.

Figure 181: Existing carriers cannot be replaced

7 Sites, Radio Units and Antennas

Sites are one of the most important things that WiMAP-4G depends on. A project cannot be planned without sites because they are the main aspect of every calculation. There are different types of sites, radio units, and antennas available and they have all their advantages and disadvantages. An advanced knowledge of antenna types is useful to make projects succeed. For example since the costs of each antenna type differ, a project should not be expensive if that is not necessary. So every user should make some investigations on sites, radio units, and antennas before continuing with this chapter. It is also necessary to take a look at the involved parameters used for antennas and calculations.

7.1 Antennas

There are a few preconfigured antennas, but depending on the project other may be needed to make a proper calculation. Different companies offer different antennas with different parameters. Antennas should be created to design the project as close to reality as possible.

7.1.1 Create Antennas

As mentioned before, new antennas sometimes need to be added to make calculations with the exact antenna type for a proper result. WiMAP-4G allows the creation of antennas with the help of patterns.



7.1.1.1 How to Create Antennas

1. *Open a site or radio unit (like in 7.3.2 or 7.2.2) or right-click any antenna in the Sites tab and click on **New**.*

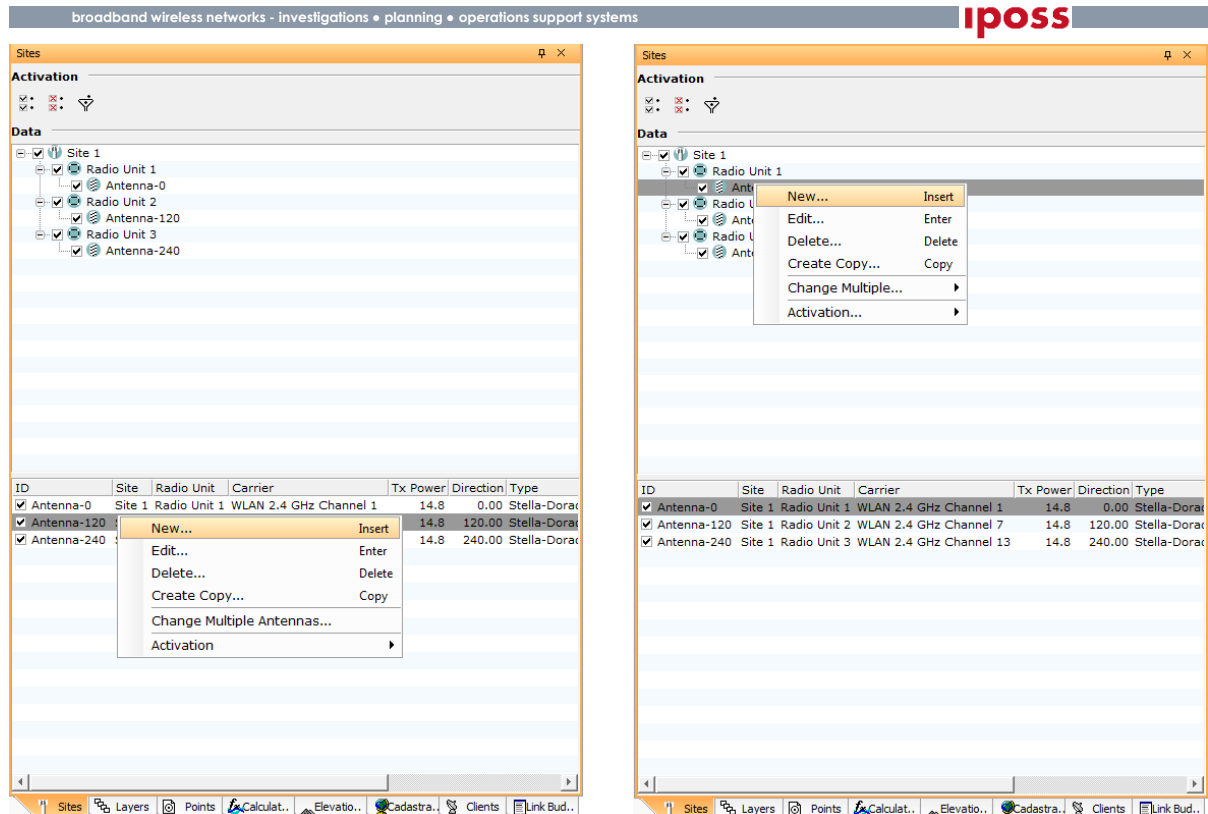


Figure 182: Right-click in sites tab and click on New in context menu

2. The antenna settings window will be opened.

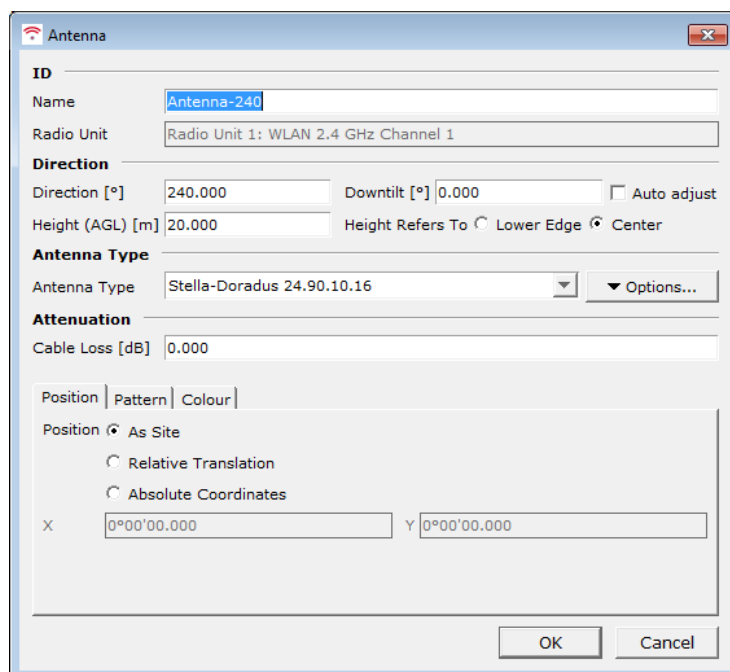


Figure 183: Antenna Settings window

3. If all parameter are set, *click on **OK***. To save the antenna completely, the setting windows of radio unit and site has also to be closed with the **OK** button.

4. The new antenna will appear on the map and in the Sites-tab.

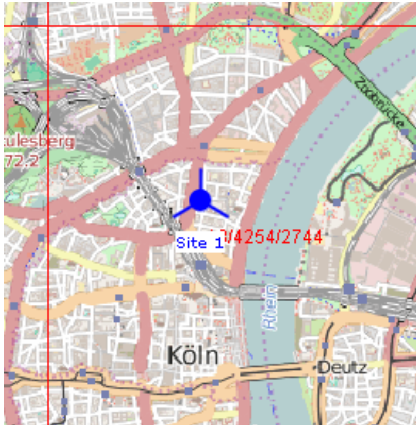


Figure 184: View of site with antenna on the map



7.1.1.2 How to Create Antenna Types

1. Choose **Antenna-Types**→ **Create** or **Antenna-Types**→ **Edit** and click on **New**.

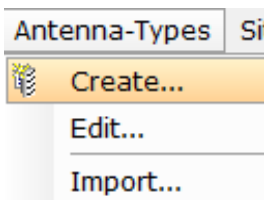


Figure 185: Create antenna-types

2. The antenna-type settings window will be opened. The antenna pattern can be imported while creating antennas.

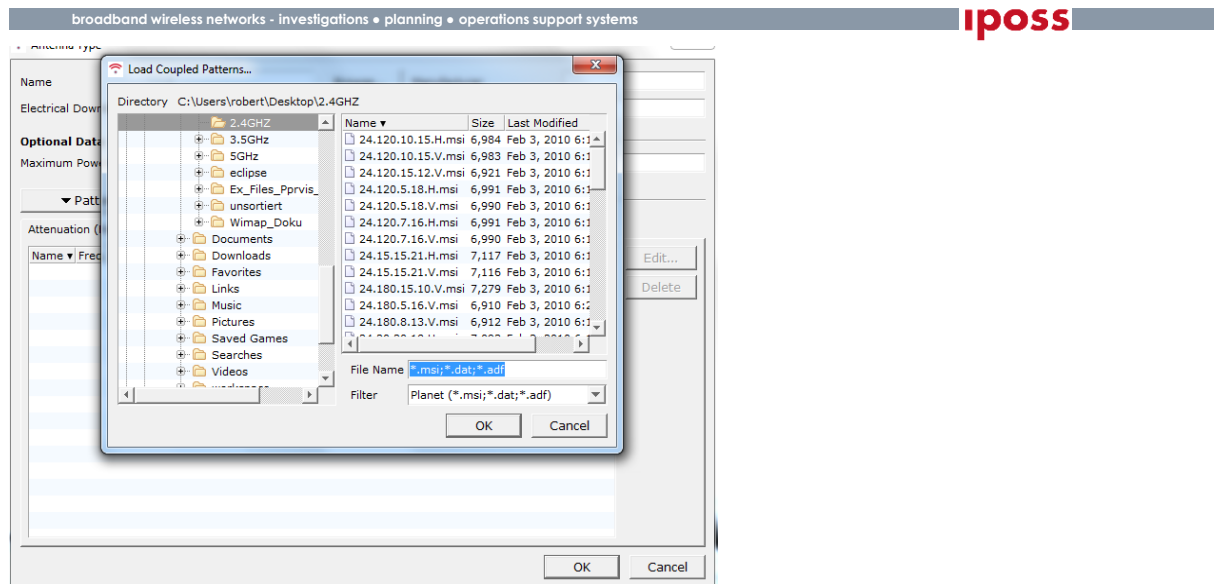


Figure 186: Antenna-type settings with importing the antenna pattern

It is necessary to create an antenna pattern which contains all information about the vertical and horizontal attenuation. These patterns can be loaded from files. The data type needs to be .msi, .dat or .adf. The patterns can be downloaded from the manufacturer site, but sometimes they need to be created manually. The pattern files can be chosen later. Pattern files contain antenna names so there would be less input needed, if a pattern file was chosen right away.

*Choose a file and click on **OK** respectively **Cancel** to cancel the import.*



A short introduction how to create pattern files can be found in chapter 7.1.5

3. If no pattern file has been imported, *edit the name and manufacturer according to the desired antenna and choose electrical downtilt.* Advanced users can add **Maximum Power** and **Antenna Type Height**.

broadband wireless networks - investigations • planning • operations support systems

Name: 24 12010H Browse... Manufacturer: STELLA_DORADUS

Electrical Down tilt From [*]: 0.000 Electrical Down tilt To [*]: 0.000

Optional Data

Maximum Power [dBm]: 20.000 Antenna Type Height [mm]:

▼ Patterns

Attenuation (Horz.) | Attenuation (Vert.) | Gain

Name	Freq. [MHz]	Elect. [*]	Pol.

Edit... Delete

OK Cancel

Figure 187: Antenna-type Settings

- To complete antenna creation a pattern is now necessary. Trying to complete the creation without a pattern brings up the following message:



Figure 188: A pattern is required for antenna creation

To load a pattern, click **Patterns→Load Single Pattern**. If there are more than one pattern available for the same antenna, click **Patterns→Load Coupled Patterns**.

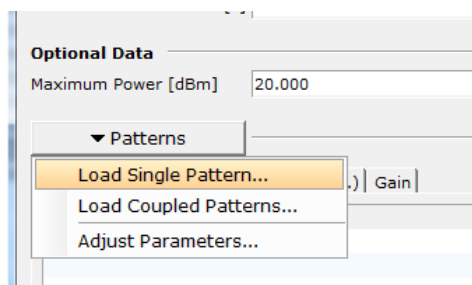


Figure 189: Load single or multiple patterns

- Select a pattern which is either a .mis or a .dat or an .adf file and click on **OK**. If this is a valid pattern, a line will be added in the attenuation table.

▼ Patterns			
Attenuation (Horz.)		Attenuation (Vert.)	Gain
Name ▼	Freq. [MHz]	Elect. [°]	Pol.
24.120.10.15.H	2442.000	0.000	Other

Figure 190: A valid pattern

- The electrical downtilt for a pattern can be edited by selecting the pattern and clicking on **OK**. A window appears and the downtilt can be changed for +/-45° and other.

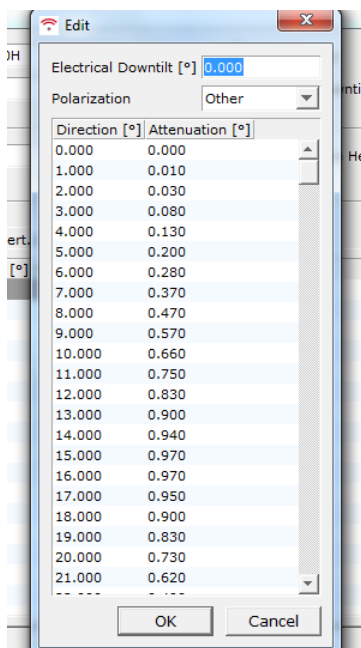


Figure 191: Antenna attenuation

If everything is edited and a pattern has been imported, *click **OK** to complete*. If there are any error messages, follow the instructions from 1-6. If everything went fine, the new antenna can be used while creating sites.

7.1.2 Editing Antennas

Sometimes antennas need to be edited. The next chapter will explain how to edit an antenna setting.



7.1.2.1 How to Edit Antennas

- Open a site or radio unit (like in 7.3.2 or 7.2.2), select an antenna or right-click the desired antenna in Sites tab and click on **Edit**.

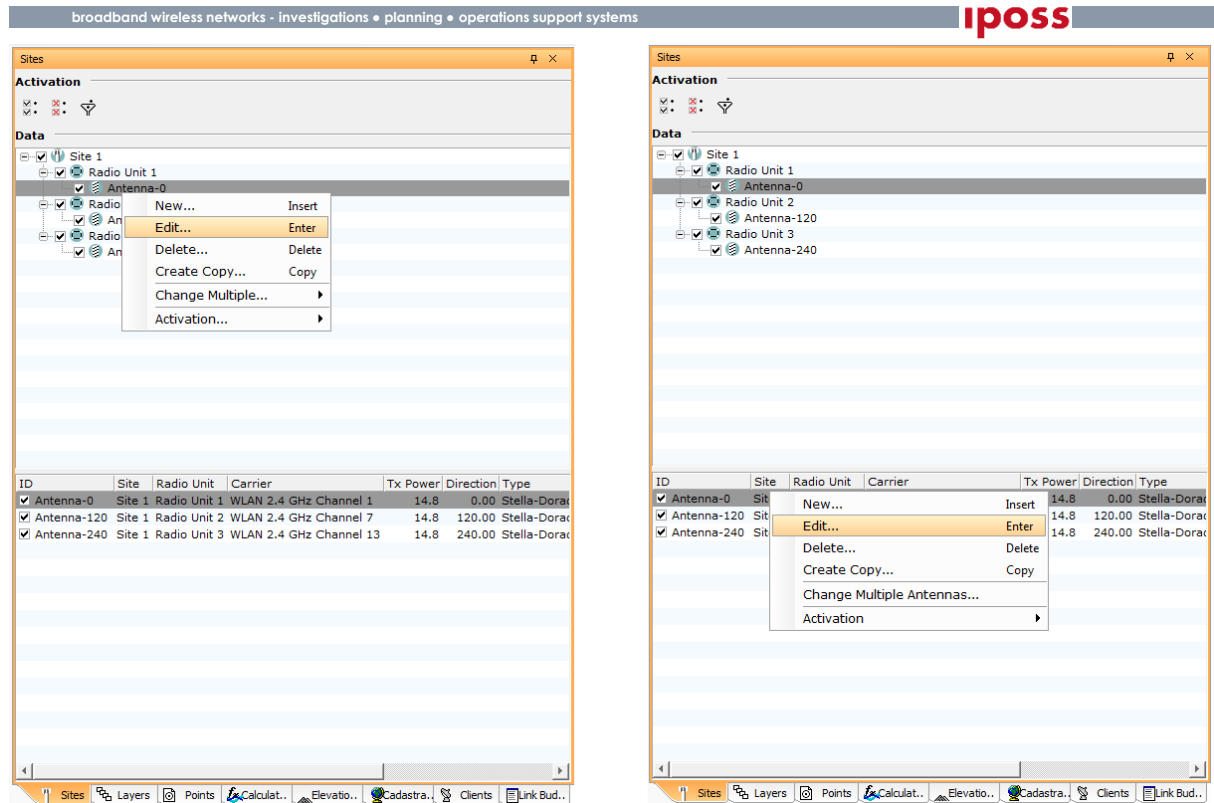


Figure 192: Right-click in sites tab and click on Edit in context menu

2. *Change the desired parameters and click on **OK**.*

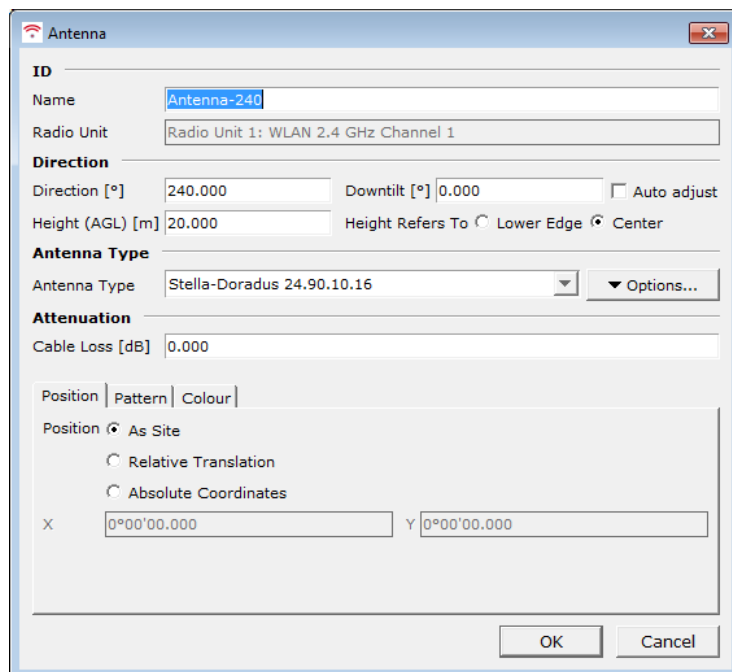


Figure 193: Antenna Settings window

3. To save the changes, the setting windows of radio unit and site has also to be closed with the **OK** button. By clicking **Cancel**, all changes will be lost.



Antennas can be deleted. *In this case follow the steps described above and click on **Delete**.*



7.1.2.2 How to Edit Antenna Types

1. Choose **Antenna Types**→ **Edit**.

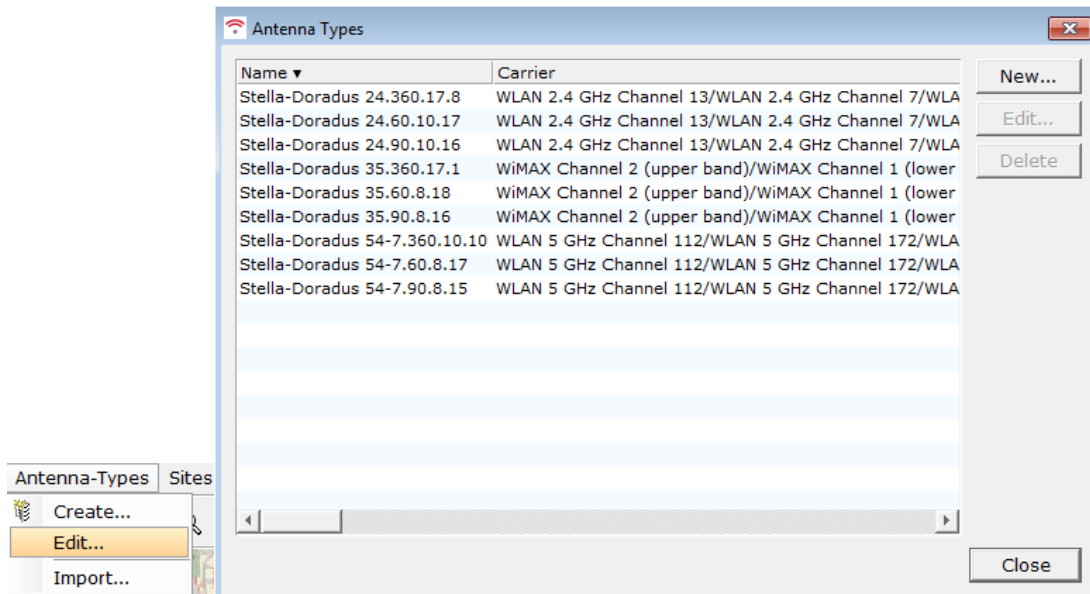


Figure 194: Edit antenna-types

2. Choose the antenna-type from the list and click on **Edit**.

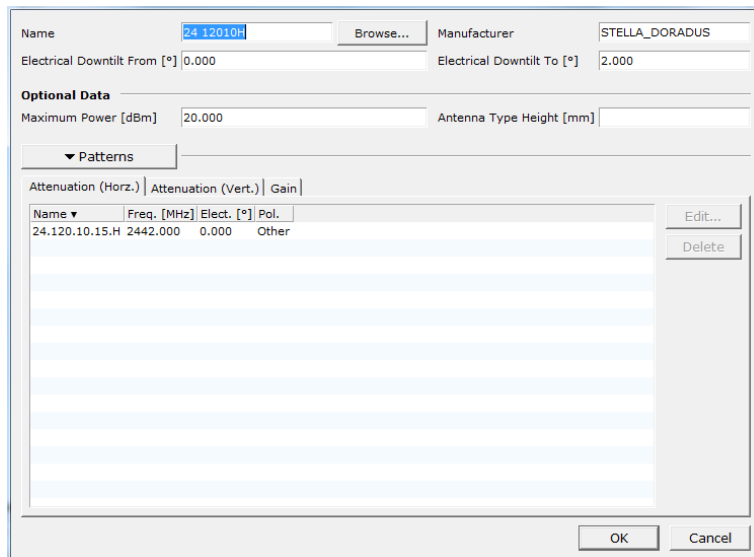


Figure 195: Antenna-type Settings

3. Edit the parameters and click on **OK**.



Antennas can be deleted. *In this case follow the steps described above and click on **Delete**.*



7.1.3 How to Copy Antennas

1. Right-click the desired antenna in the Sites tab and choose **Create Copy**.

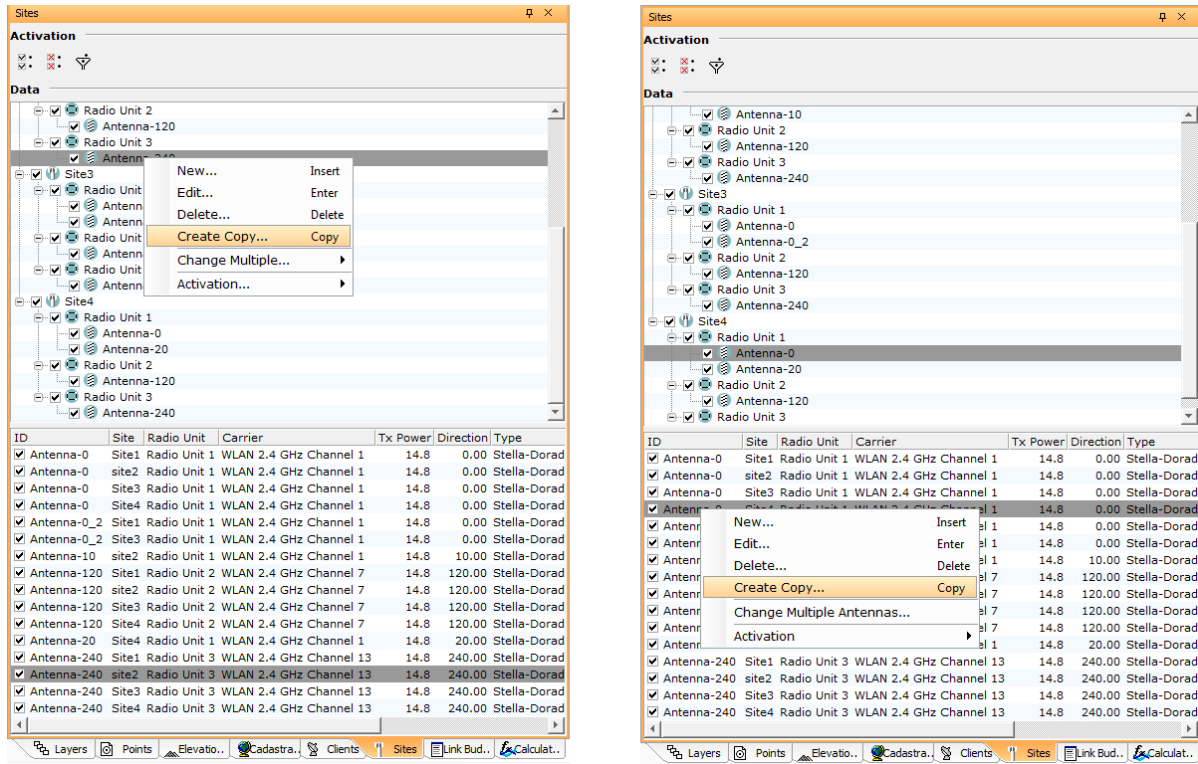
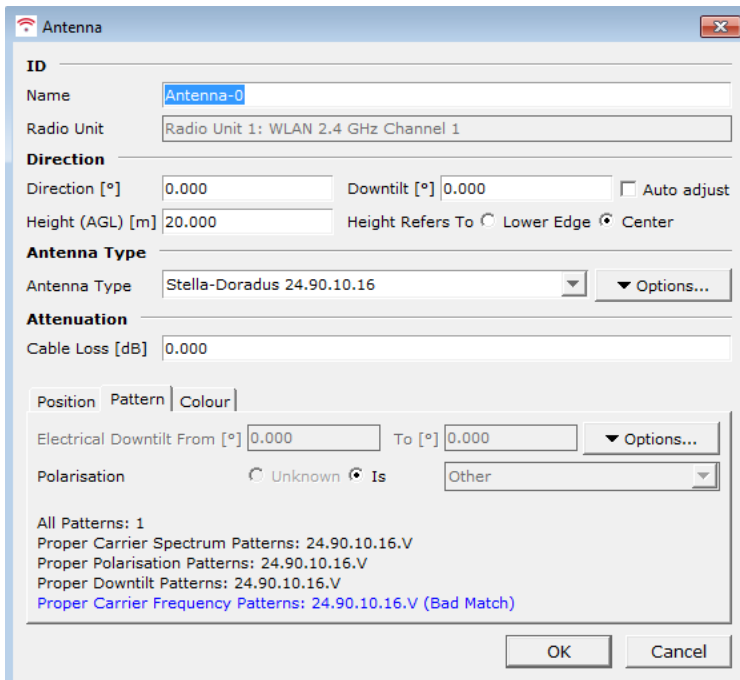


Figure 196: Right-click in the sites tab and click on Create Copy in context menu

2. The setting window of an antenna with the same parameter like the selected antenna will be opened and can be edited.



Antenna

ID

Name: Antenna-0

Radio Unit: Radio Unit 1: WLAN 2.4 GHz Channel 1

Direction

Direction [°]: 0.000 Downtilt [°]: 0.000 ☐ Auto adjust

Height (AGL) [m]: 20.000 Height Refers To: ☐ Lower Edge ☒ Center

Antenna Type

Antenna Type: Stella-Doradus 24.90.10.16 ▼ Options...

Attenuation

Cable Loss [dB]: 0.000

Position Pattern Colour

Electrical Downtilt From [°]: 0.000 To [°]: 0.000 ▼ Options...

Polarisation: ☐ Unknown ☒ Is Other

All Patterns: 1
 Proper Carrier Spectrum Patterns: 24.90.10.16.V
 Proper Polarisation Patterns: 24.90.10.16.V
 Proper Downtilt Patterns: 24.90.10.16.V
 Proper Carrier Frequency Patterns: 24.90.10.16.V (Bad Match)

OK Cancel

Figure 197: Antenna settings of a copied antenna

3. After all changes, *click on **OK** to save the settings.* This new antenna will be added to the radio unit and site of the selected antenna.



7.1.4 How to Change all Antennas Faster

1. Choose **Sites**→**Change Multiple**→**Antennas**.

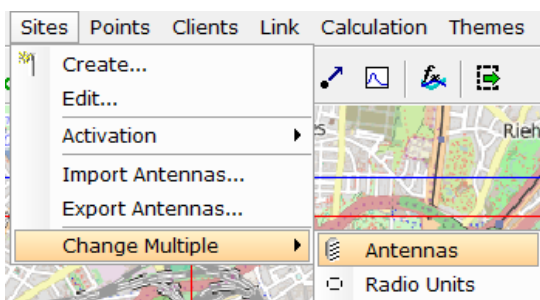


Figure 198: Change multiple antennas

2. Choose *which specific antennas should be edited* (effects antennas of a whole site), *or choose all antennas alternatively all active antennas for editing.*

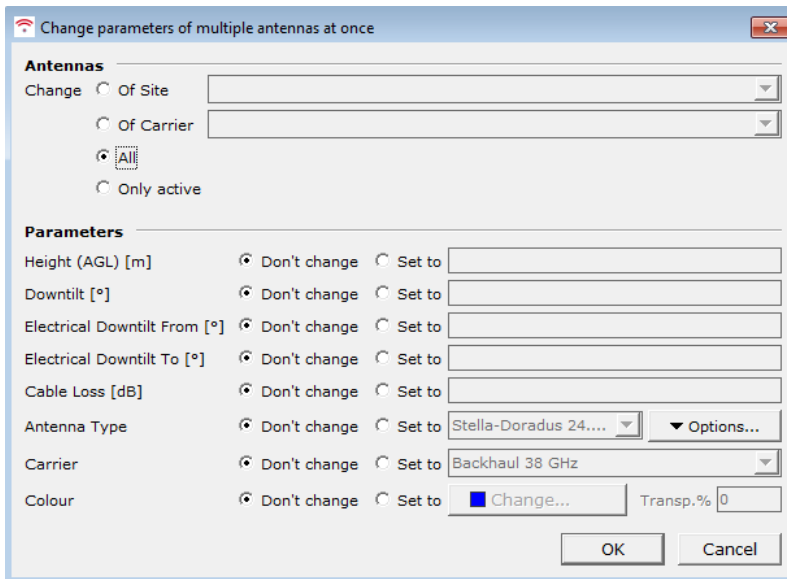


Figure 199: Choosing all antennas option

3. Choose the desired parameter by changing the option to **Set to** and change the parameter.

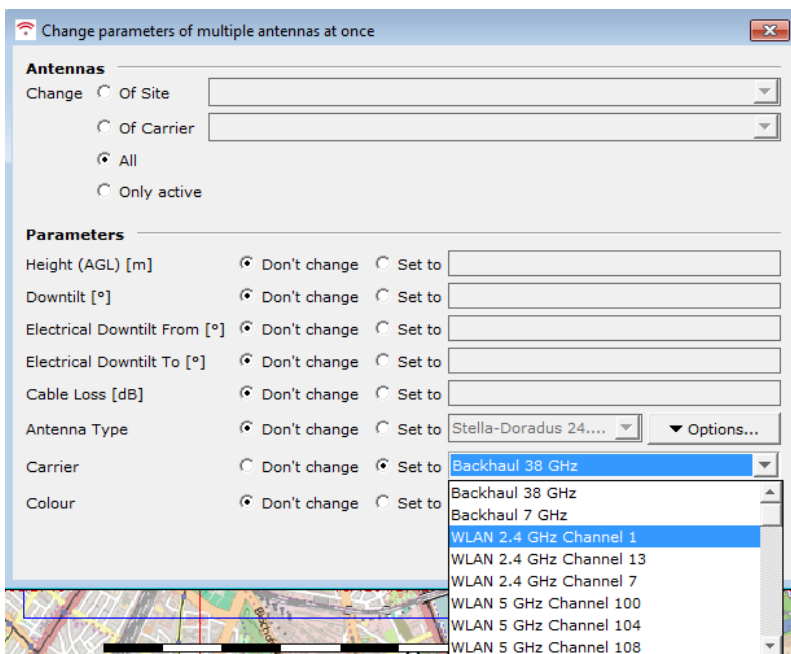


Figure 200: Setting the new carrier for all antennas

4. Click on **OK** to save changes for the desired antennas.



7.1.5 How to Create a Pattern File

Creating a pattern file is necessary for importing an antenna in case the manufacturer does not offer pattern files for download. Only a text editor is needed to create those pattern files.

1. *Open editor (Hold down Win-Button and press R, type **Notepad** and click on **OK**).
The editor should appear at once:*

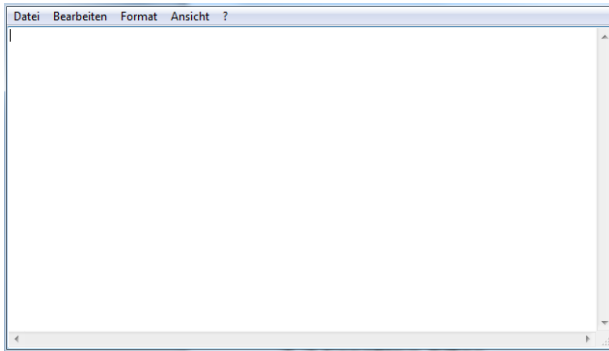


Figure 201: The windows editor

2. Parameter needed for pattern creation:
 - **Description of the antenna**
 - **Name of the antenna**
 - **Frequency**
 - **Horizontal and vertical angle of the signal created from the antenna**
 - **Front to back ratio (power gain between front and rear of the antenna)**
 - **Antenna gain**
 - **Tilt (mechanical or electrical)**
 - **Polarization of the antenna (horizontal or vertical)**
 - **Attenuation parameters for 360° horizontal and vertical**

These parameters are all you need to create a valid antenna pattern with a text editor.
Add the following lines to the editor:

- **Description of the antenna:**
 - NAME 24.120.10.15
 - This is the standard description for antenna in WiMAP-4G.
 - 24: Antenna frequency (for this antenna 2.4 GHz)
 - 120: Horizontal angle
 - 10: Vertical angle
 - 15: Antenna gain in dBi
- **Name of the antenna:**

- MAKE Stella Doradus
- In this case Stella Doradus is the name of the antenna.
- **Antenna frequency:**
 - FREQUENCY 2442
 - Depending on the frequency used change 2.442 to 3.500 for 3.5 GHz.
- **Horizontal angle:**
 - H_WIDTH 360
 - Horizontal angle can be a value between 0 and 360°.
- **Vertical Angle:**
 - V_WIDTH 9
 - Vertical angle can be a value between 0 and 360°.
- **Front to back:**
 - FRONT_TO_BACK 10
- **Antenna gain:**
 - GAIN 10 dBi
- **Tilt:**
 - TILT MECHANICAL
- **Polarization:**
 - POLARIZATION V
 - Set POLARIZATION H for horizontal polarization.

The editor should look like this:

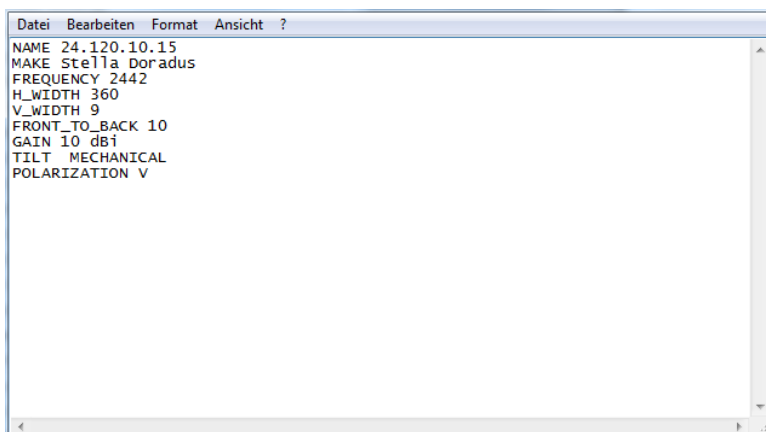


Figure 202: Editor with a few settings

3. Add the horizontal and vertical attenuation parameters from 0 to 360 using this style.

HORIZONTAL	360	VERTICAL	360
0	0	0	0
1	0	1	0.03
2	0	2	0.5
3	0	3	1.46
4	0.01	4	2.972
5	0.01	5	5.203
6	0.02	6	8.489
7	0.03	7	12.752
8	0.04	8	25.13
9	0.05	9	20.546
10	0.06	10	14.395
11	0.07	11	11.95524
12	0.09	12	11.1492
...	...	...	...
360	0	360	0

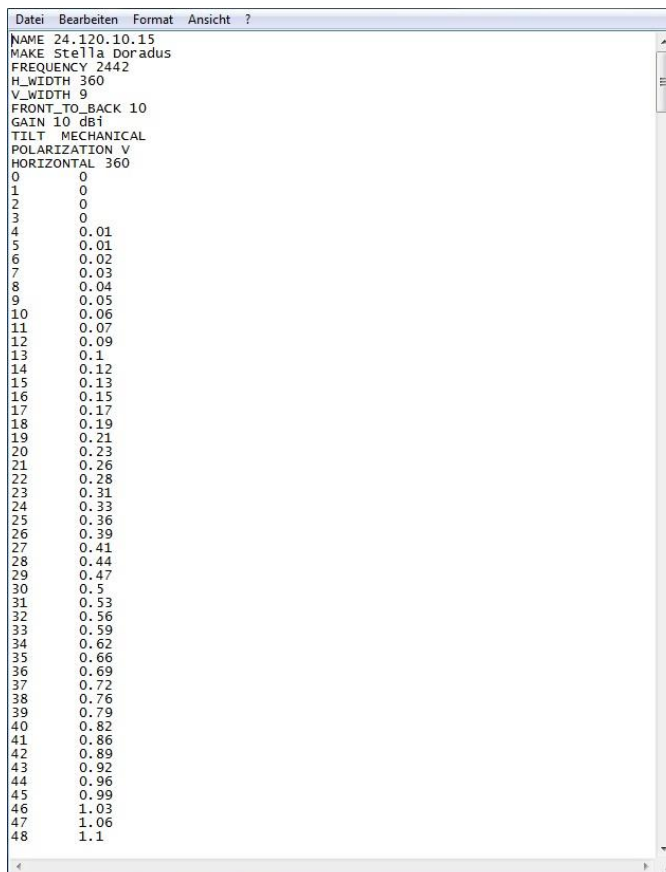


Figure 203: Editor with attenuation parameters

4. Choose **File**→**Save as** and save file as .msi.



Figure 204: Save the new file as .msi

There is a .msi file in the chosen file path right away, which can be used as a pattern for this antenna.

7.1.6 Export Antennas

To export antenna information from an existing project it might be necessary to work in other projects with the same antenna set or to work with these antennas in other programs that allow antenna-import.



7.1.6.1 How to Export Antennas

1. Choose **Sites**→**Export Antennas**.

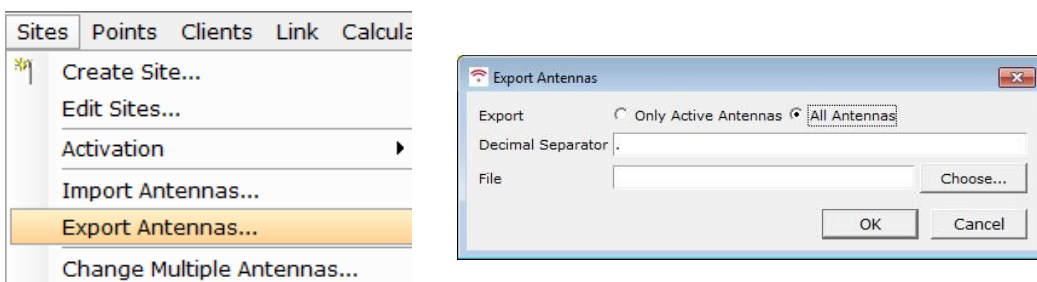


Figure 205: Export antennas

2. Choose whether to export all antennas which is set by default or only the active antennas. The decimal separator only affects the layout of the created .csv file. Click on **Choose** to browse folders and enter a file name.

3. Click **OK** to export the antennas.

7.1.7 Import Antennas

Importing antennas is possible with WiMAP-4G. Both, importing antenna information from other projects to the active working set and importing antennas data from other programs that allow exporting data in .csv format is provided.



7.1.7.1 How to Import Antennas

1. Choose **Sites**→**Import Antennas**.

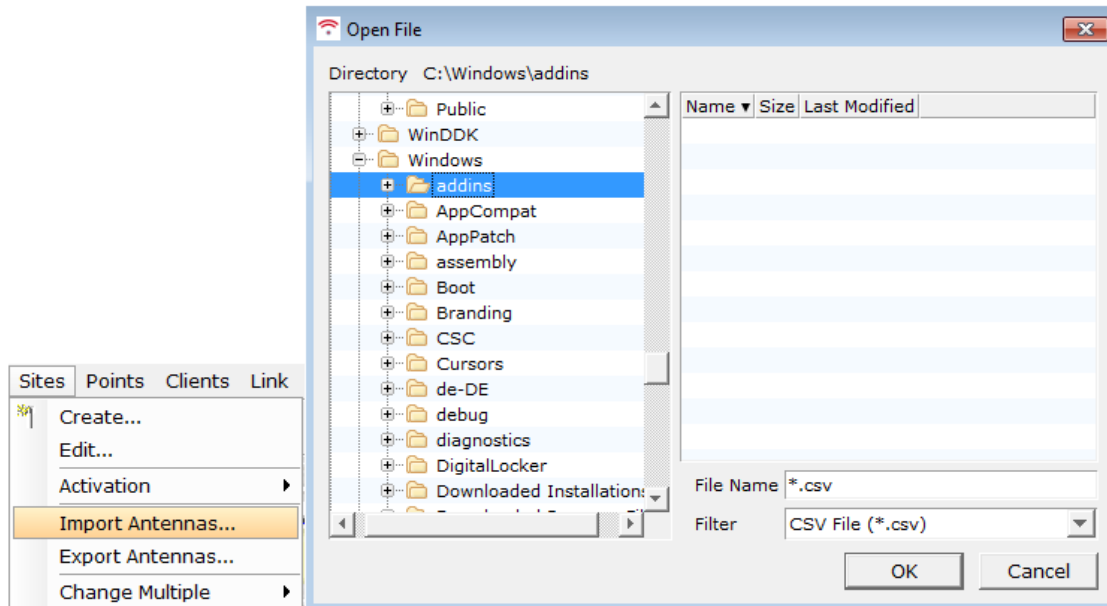


Figure 206: Import antennas

2. Set **Decimal Separator** for the imported parameters and choose file.

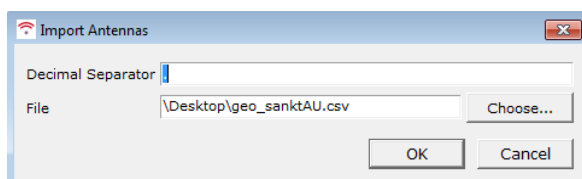


Figure 207: Dialogue for setting the decimal separator

3. The imported antennas appear on the map:

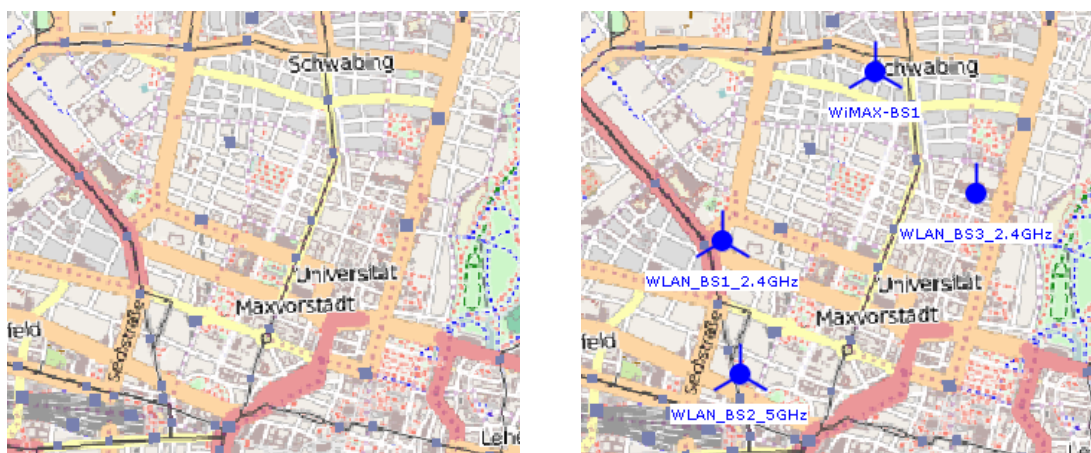


Figure 208: Imported antennas shown up on the map with their corresponding sites



7.1.7.2 How to Import Antenna Types

Importing antenna types is possible with WiMAP-4G, too. Antenna types can be imported from other projects or from other programs that support the .rad export. With this feature, specific antenna types can be imported and do not need to be created for every project again and again.

1. Choose **Antenna-Types**→**Import**.

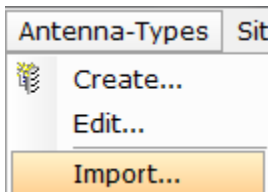


Figure 209: Import antenna-types

2. Choose the .rad file that holds the new antenna types and click on **OK** to import these antenna types.

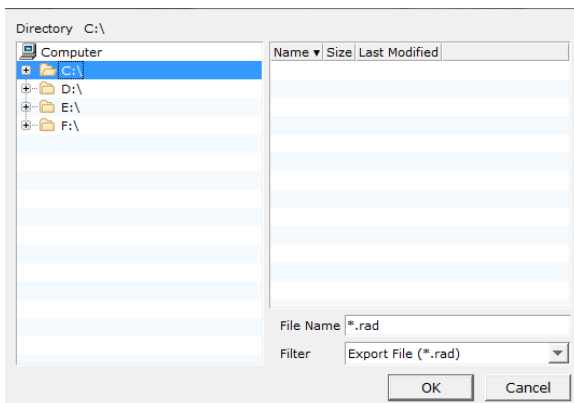


Figure 210: Choosing file

3. If everything worked out successfully, the log shows the following information and the imported antenna types are available now.

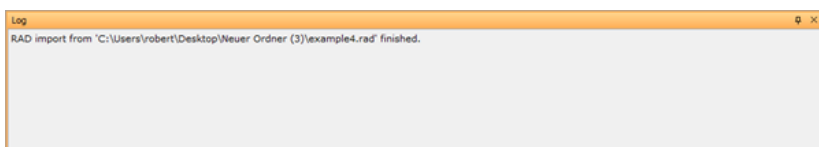


Figure 211: Log information for the current import

A possible scenario: Existing antenna types will not be replaced. Instead of replacing the log shows the following information:

Object Stella-Doradus 24.90.10.16 (UUID=21b4e388-3916-4606-b6a6-acd81163d2dc) already exists and has not been replaced.

Figure 212: Log with warning message

7.1.8 Activate or Deactivate Antennas

Sometimes antennas need to be activated or deactivated, for instance, to make calculations faster. This is important for larger projects. There are several ways to activate or deactivate antennas. One of these ways is described in the next chapter.



7.1.8.1 How to Activate/Deactivate Antennas

3. To set antennas active or inactive, *open the **Sites** tab in the **Project-Explorer**.*

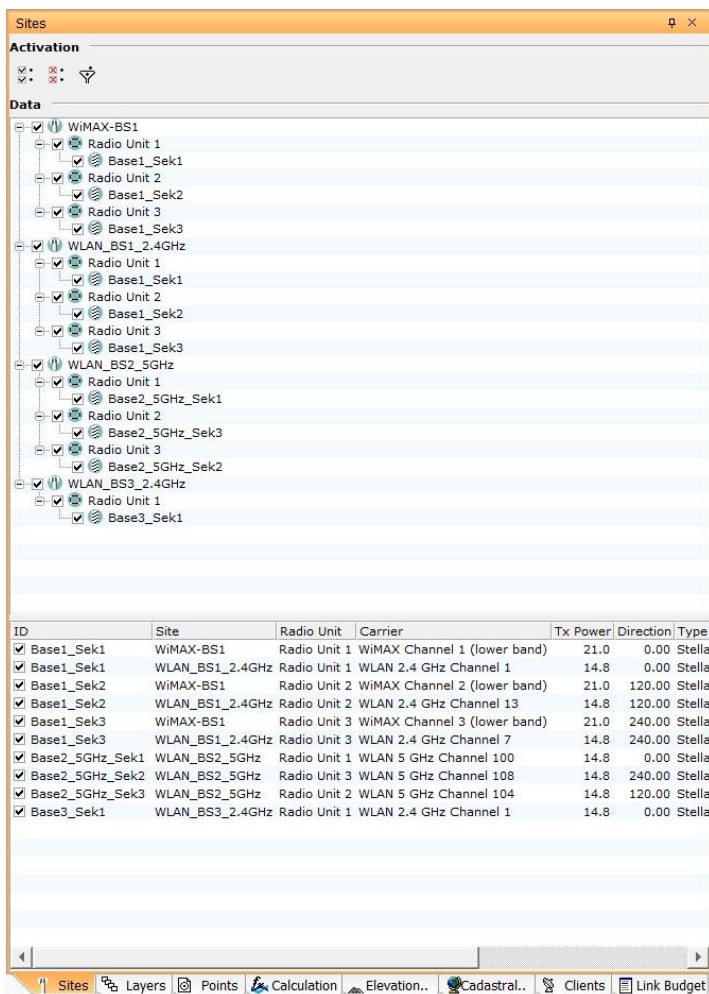


Figure 213: The sites tab

4. In a table or a tree data of the window, all antennas can be activated or deactivated.

5. As an alternative *choose **Sites**→**Activation**→**Antennas**→**Activate All/Deactivate All***



7.1.8.2 How to Invert Activation

1. *Open the Site tab in the Project-Explorer and right-click on an antenna.*
2. *Select **Activation**→**Invert Activation**.*

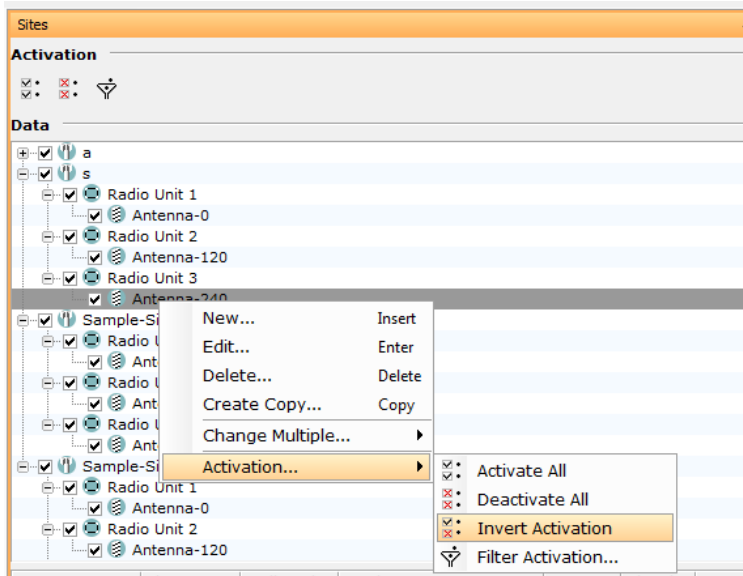


Figure 214: Invert activation of an antenna

3. **Invert Activation** function activates all deactivate antennas, if the selected antenna was activated or vice versa.

7.1.8.3 How to Activate Antennas by a Filter

1. *Open the Site tab in the Project-Explorer and right-click on an antenna.*
2. *Select **Activation**→**Filter Activation**.*

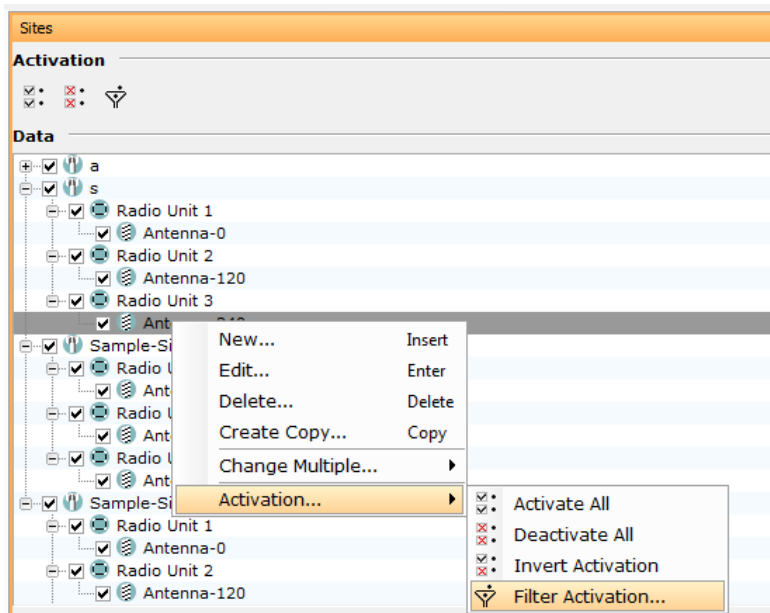


Figure 215: Context menu for filter activation

3. Select and set the filter parameters and click on **OK** to select and apply the filter.

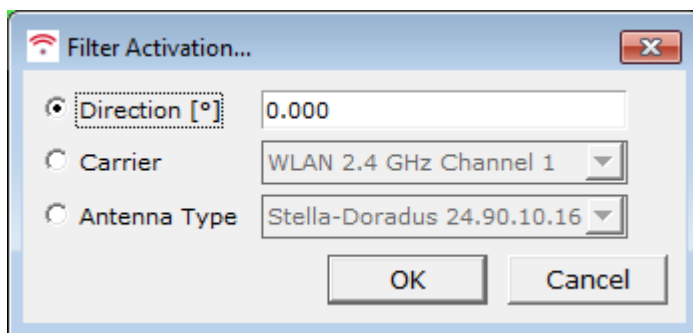


Figure 216: Filter activation

4. After applying the filter parameter will activate all affected antennas.

7.1.9 Invalid Antennas

An antenna will be invalid if the carrier of the radio unit or the associated antenna type does not match. The colour font of the antenna will change to red and the antenna is deactivated for calculation. The following figures show clearly how the invalid antennas look in WiMAP-4G projects.

 Site

ID

Name

Position

X

Y

Z [m]

Site Description

Country

State

District

Municipality

Place

Street

Description

Site ID

Colour

Colour

Transp.%

Components

 Radio Unit 1

 Antenna-0

 Radio Unit 2

 Antenna-120

 Radio Unit 3

 Antenna-240

Figure 217: Site settings with invalid antennas

The 'Sites' window displays a tree view of site configurations on the left and a table of site data on the right.

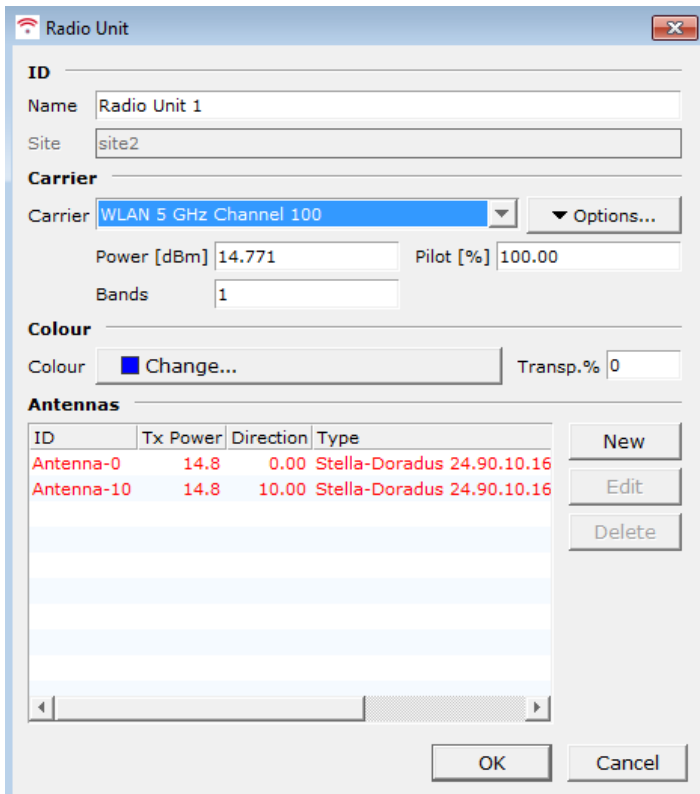
Tree View Structure:

- a**
 - Radio Unit 1
 - Antenna-0
 - Radio Unit 2
 - Antenna-120
 - Radio Unit 3
 - Antenna-240
- s**
 - Radio Unit 1
 - Antenna-0
 - Radio Unit 2
 - Antenna-120
 - Radio Unit 3
 - Antenna-240
- Sample-Site**
 - Radio Unit 1
 - Antenna-0
 - Radio Unit 2
 - Antenna-120
 - Radio Unit 3
 - Antenna-240

Table Data:

ID	Site	Radio Unit	Carrier	Tx Power	Direction	Type
✓ Antenna-0	a	Radio Unit 1	WLAN 2.4 GHz Channel 1	14.8	0.00	Stella
✓ Antenna-0	s	Radio Unit 1	WLAN 5 GHz Channel 112	14.8	0.00	Stella
✓ Antenna-0	Sample-Site	Radio Unit 1	WLAN 2.4 GHz Channel 1	14.8	0.00	Stella
✓ Antenna-0	Sample-Site	Radio Unit 1	WLAN 2.4 GHz Channel 1	14.8	0.00	Stella
✓ Antenna-120	a	Radio Unit 2	WLAN 2.4 GHz Channel 7	14.8	120.00	Stella
✓ Antenna-120	s	Radio Unit 2	WLAN 2.4 GHz Channel 7	14.8	120.00	Stella
✓ Antenna-120	Sample-Site	Radio Unit 2	WLAN 2.4 GHz Channel 7	14.8	120.00	Stella
✓ Antenna-120	Sample-Site	Radio Unit 2	WLAN 2.4 GHz Channel 7	14.8	120.00	Stella
✓ Antenna-240	a	Radio Unit 3	WLAN 2.4 GHz Channel 13	14.8	240.00	Stella
✓ Antenna-240	s	Radio Unit 3	WLAN 2.4 GHz Channel 13	14.8	240.00	Stella
✓ Antenna-240	Sample-Site	Radio Unit 3	WLAN 2.4 GHz Channel 13	14.8	240.00	Stella
✓ Antenna-240	Sample-Site	Radio Unit 3	WLAN 2.4 GHz Channel 13	14.8	240.00	Stella

Figure 218: Site tab with invalid antennas



Radio Unit

ID

Name: Radio Unit 1

Site: site2

Carrier: WLAN 5 GHz Channel 100

Power [dBm]: 14.771 Pilot [%]: 100.00

Bands: 1

Colour: Change... Transp.%: 0

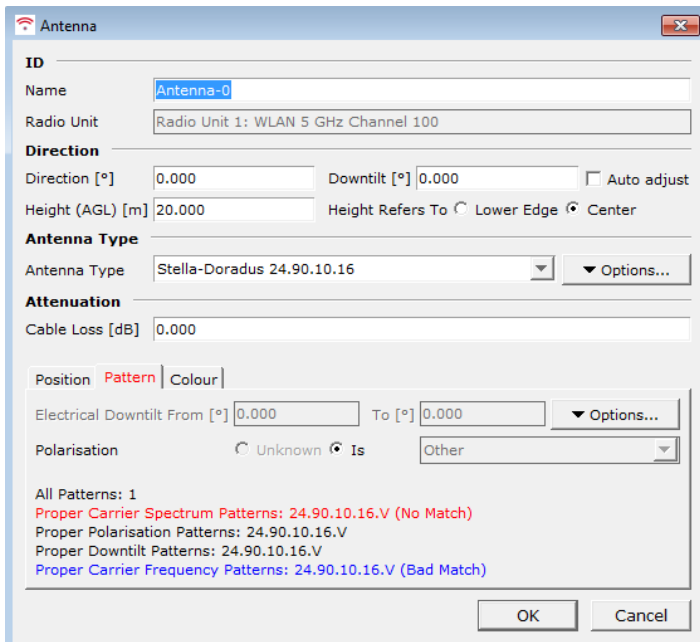
Antennas

ID	Tx Power	Direction	Type
Antenna-0	14.8	0.00	Stella-Doradus 24.90.10.16
Antenna-10	14.8	10.00	Stella-Doradus 24.90.10.16

New Edit Delete

OK Cancel

Figure 219: Radio unit with invalid antennas



Antenna

ID

Name: Antenna-0

Radio Unit: Radio Unit 1: WLAN 5 GHz Channel 100

Direction

Direction [°]: 0.000 Downtilt [°]: 0.000 Auto adjust

Height (AGL) [m]: 20.000 Height Refers To: Lower Edge Center

Antenna Type

Antenna Type: Stella-Doradus 24.90.10.16

Attenuation

Cable Loss [dB]: 0.000

Position: Pattern Colour

Electrical Downtilt From [°]: 0.000 To [°]: 0.000

Polarisation: Unknown Is Other

All Patterns: 1

Proper Carrier Spectrum Patterns: 24.90.10.16.V (No Match)

Proper Polarisation Patterns: 24.90.10.16.V

Proper Downtilt Patterns: 24.90.10.16.V

Proper Carrier Frequency Patterns: 24.90.10.16.V (Bad Match)

OK Cancel

Figure 220: Invalid antenna

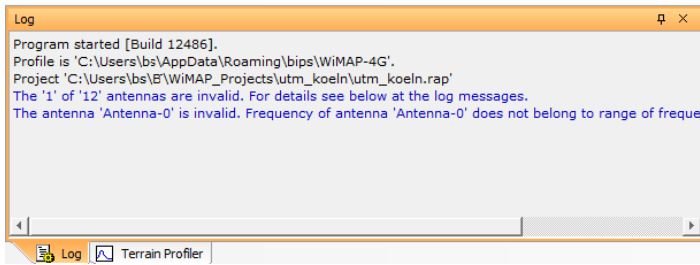


Figure 221: Log message about invalid antennas

7.1.10 Distributed/MIMO Antennas

WiMAP-4G supports distributed antennas for multi-input multi-output (MIMO) technology. MIMO technology is used to enhance the performance of signal transmission. In practice the distributed antennas can interfere with each other although their signals are transmitted over different mediums. To create distributed antennas at least two antennas per radio unit are required.



7.1.10.1 How to Create Distributed/MIMO Antennas

1. *Open a radio unit* that should have the distributed antennas *and click on **New*** to create new antenna.

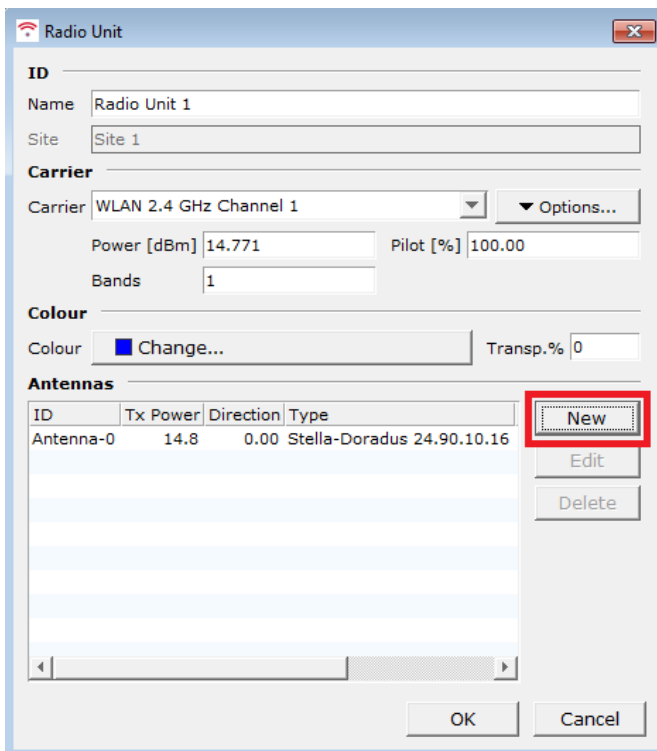


Figure 222: Creating a new antenna

2. The antenna settings window will be opened. *Edit the settings and click on **OK**.*

3. If the radio unit has one antenna *follow the steps described above*.
4. Now the desired radio unit has the distributed antennas.

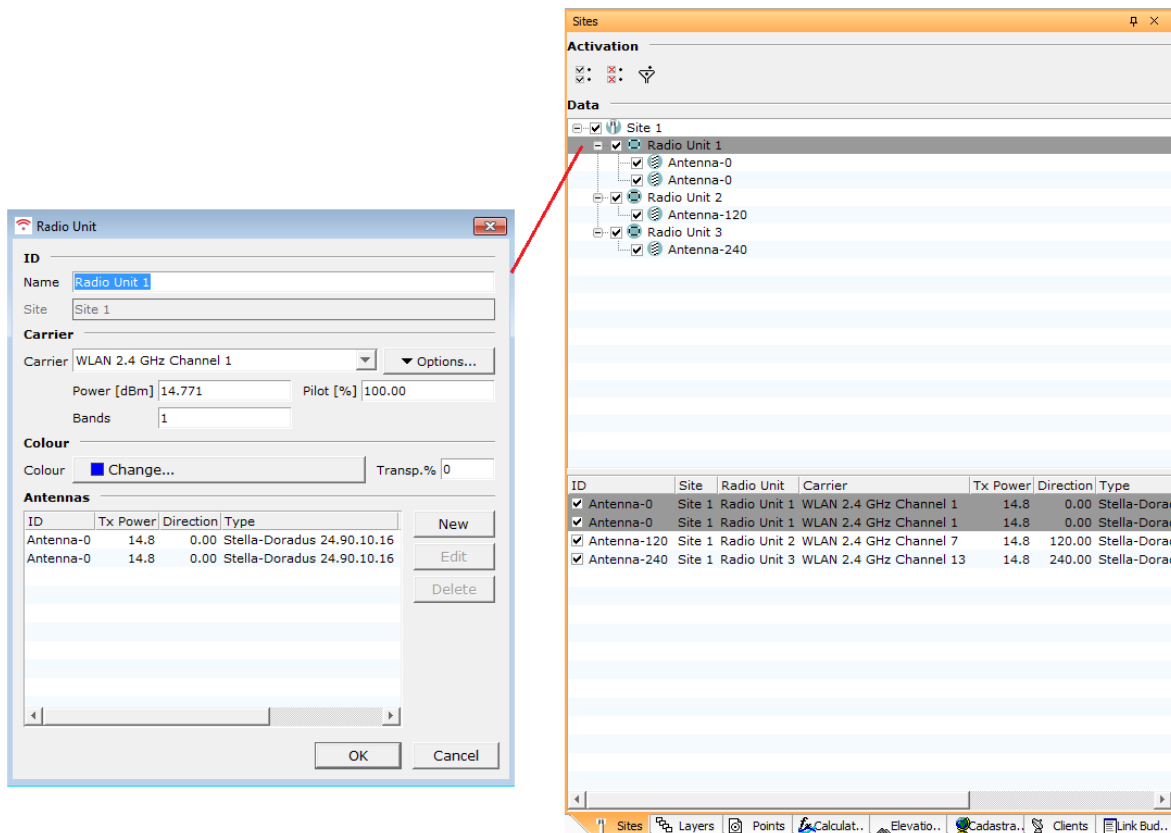


Figure 223: Radio unit with distributed antennas

5. View of the distributed antennas on the map as follows:

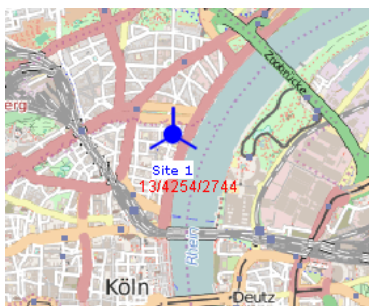


Figure 224: Distributed antennas with same directions



Figure 225: Distributed antennas with different directions



An introduction how to calculate with desired antennas can be found in chapter 10.16

7.2 Radio Units

Radio Unit represents an antenna set which can be used for distributed antennas. The radio unit can have one or more antennas but one antenna can only be combined with one radio unit. In the radio unit one can determine the carrier. The carrier consists of a channel and a technology.

The parameters of a radio unit are:

- **Carrier:** Select a carrier for the antenna. If there is no carrier available for the specific purpose, *create one by clicking on **Options**→**Carriers***.



To create or edit carriers see chapter 6.1.

- **Power (dBm):** The power of the carrier specified in dBm.



Note that there are limitations according to the power in each country (20 dBm maximum channel power for 2.4 GHz for example).

- **Pilot (%):** The pilot power of the carrier. Affects the signal radius.
Value: 1-100 %
- **Colour:** Represents the colour of a radio unit.
- **Antennas:** List of the associated antennas.



7.2.1 How to Create a Radio Unit

1. Open a site (like in 7.3.1 and 7.3.2) and choose **New→Create Radio Unit** or right-click any radio unit of the desired site in the Sites tab and click on **New**.

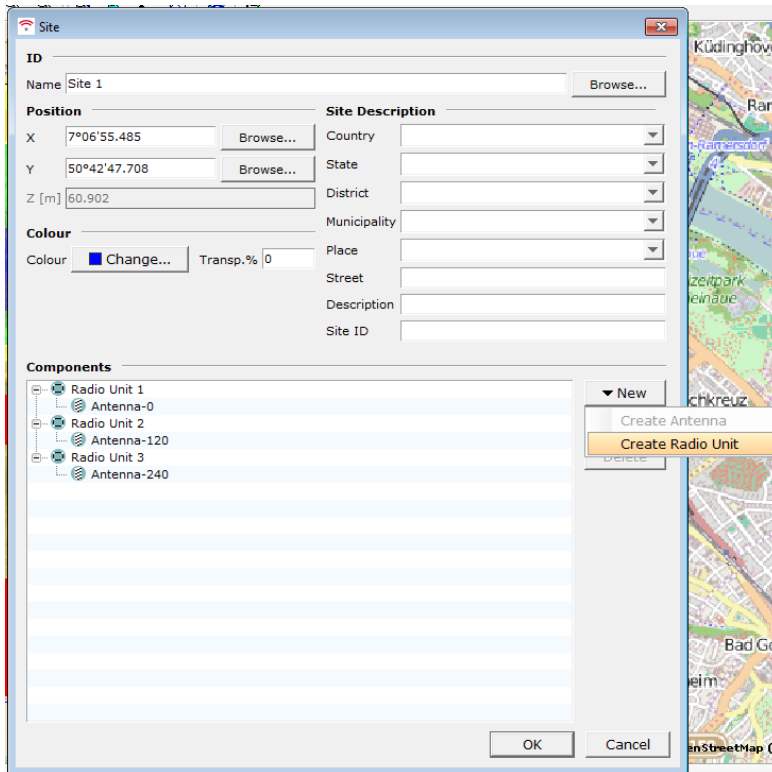
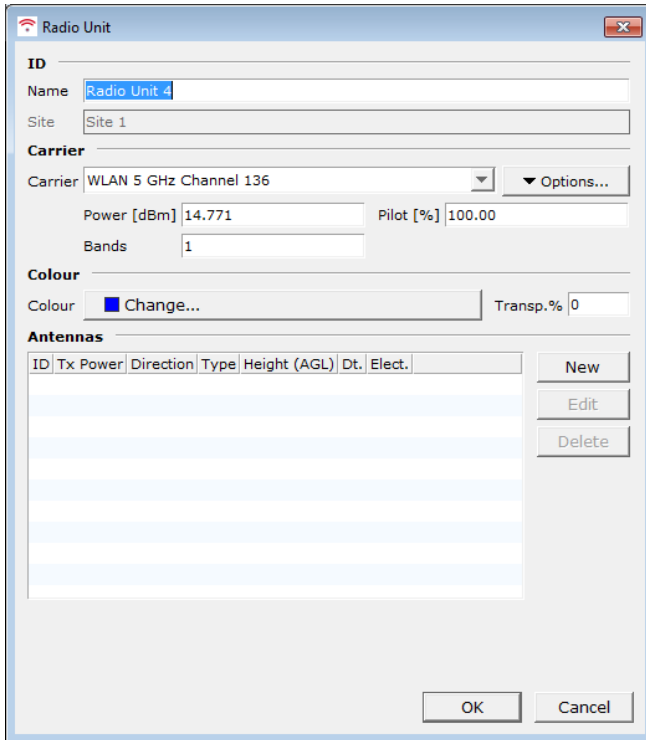


Figure 226: Site Settings window

2. Edit the parameters of new radio unit, to create antennas click on **New**.



The 'Radio Unit' settings window is shown. It has a title bar with a close button. The window is divided into several sections:

- ID**: Name (Radio Unit 4), Site (Site 1).
- Carrier**: Carrier (WLAN 5 GHz Channel 136), Power [dBm] (14.771), Pilot [%] (100.00), Bands (1). There is an 'Options...' button next to the Carrier dropdown.
- Colour**: Colour (Change...), Transp.% (0).
- Antennas**: A table with columns: ID, Tx Power, Direction, Type, Height (AGL), Dt., Elect. To the right of the table are buttons: New, Edit, Delete.

At the bottom are 'OK' and 'Cancel' buttons.

Figure 227: Radio unit settings window

3. For saving the new radio unit *click on **OK***. To save the changes of the site *click again on **OK*** in the site settings window.

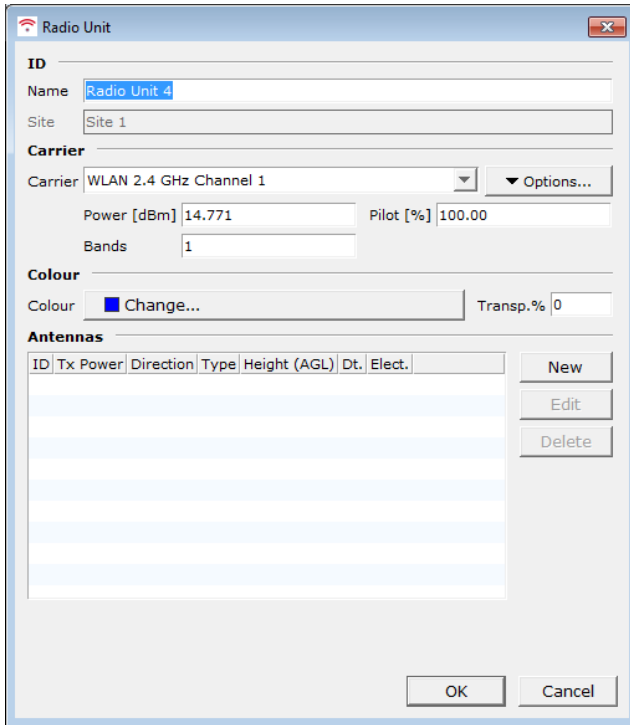


Take a look in chapter 7.1.1.1 for creating an antenna in a radio unit.



7.2.2 How to Edit a Radio Unit

1. *Open the edit window of a site (like in 7.3.2) or right-click the desired radio unit in the Sites tab and click on **Edit**.*
2. The radio unit settings window will be open.



The 'Radio Unit' dialog box is shown. It contains the following fields and controls:

- ID**: A text field containing 'Radio Unit 4'.
- Name**: A text field containing 'Radio Unit 4'.
- Site**: A text field containing 'Site 1'.
- Carrier**: A dropdown menu showing 'WLAN 2.4 GHz Channel 1' and an 'Options...' button.
- Power [dBm]**: A text field containing '14.771'.
- Pilot [%]**: A text field containing '100.00'.
- Bands**: A text field containing '1'.
- Colour**: A color selection button labeled 'Change...' and a 'Transp. %' field containing '0'.
- Antennas**: A table with columns: ID, Tx Power, Direction, Type, Height (AGL), Dt., Elect. The table is currently empty.
- Buttons**: 'New', 'Edit', 'Delete' buttons are located to the right of the Antennas table. 'OK' and 'Cancel' buttons are at the bottom right of the dialog.

Figure 228: Edit a radio unit

3. If all changes are done, *click on **OK*** to save the changes. By clicking **Cancel**, all changes will be lost.



7.2.3 How to Copy a Radio Unit

1. *Right-click the desired radio unit in the Sites-tab and choose **Create Copy**.*

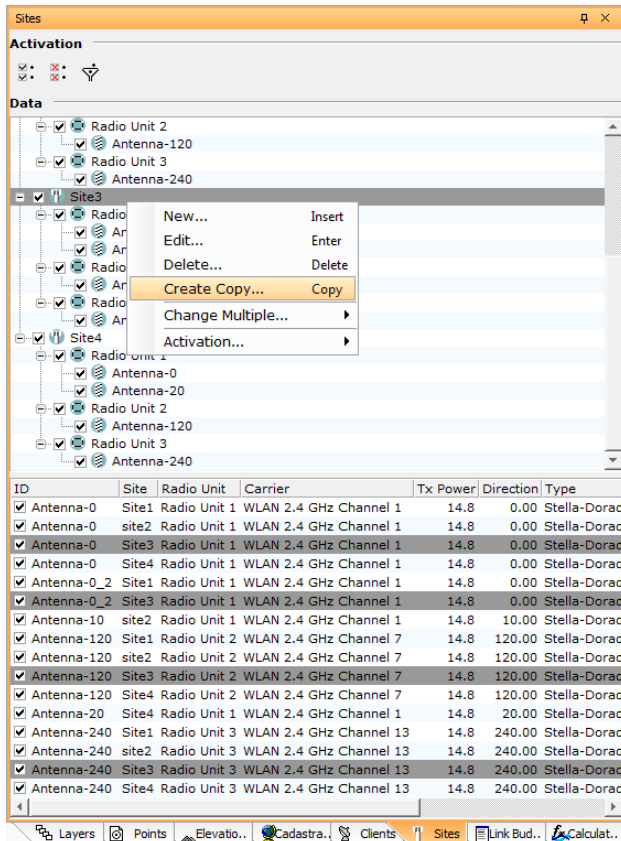


Figure 229: Copy a radio unit

2. The radio unit settings window will be opened.

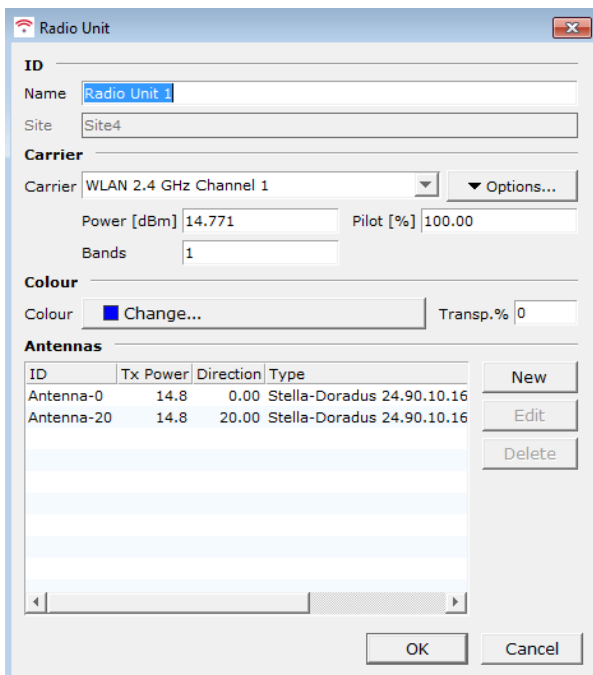


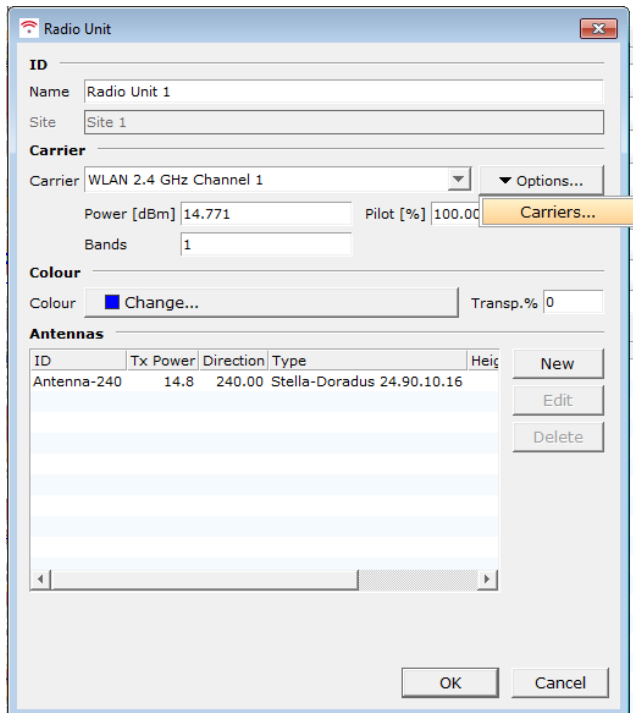
Figure 230: Edit the radio unit

3. Antennas can be created/edited/removed by clicking on **New/Edit/Delete**.
4. Click on **OK** to save changes.



7.2.4 How to Change Carrier in a Radio Unit

1. Open the desired radio unit (like in 7.2.2).
2. In the drop down menu there are only the active carriers of the radio unit. To add another carrier choose **Options→Carriers**.



Radio Unit

ID

Name: Radio Unit 1

Site: Site 1

Carrier

Carrier: WLAN 2.4 GHz Channel 1

Power [dBm]: 14.771

Pilot [%]: 100.00

Bands: 1

Colour

Colour: ■ Change...

Transp.%: 0

Antennas

ID	Tx Power	Direction	Type	Heig
Antenna-240	14.8	240.00	Stella-Doradus	24.90.10.16

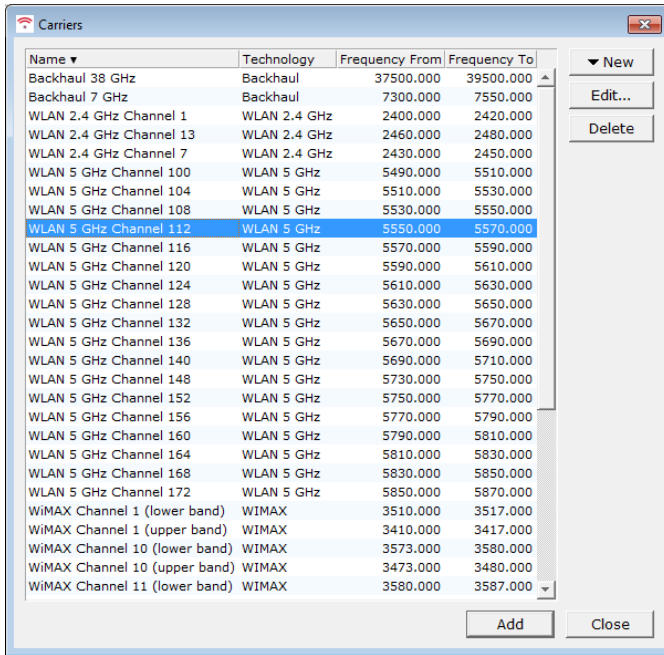
New

Edit

Delete

OK Cancel

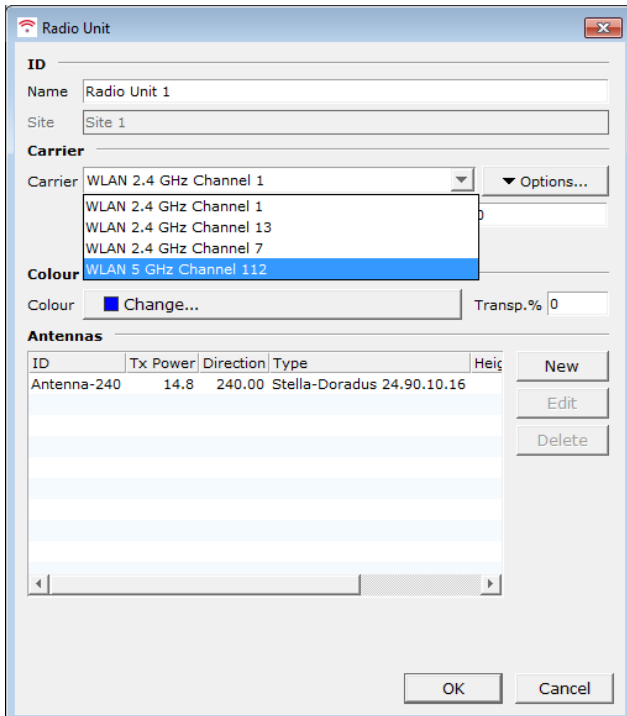
Figure 231: Radio unit settings for changing the carrier



Name	Technology	Frequency From	Frequency To
Backhaul 38 GHz	Backhaul	37500.000	39500.000
Backhaul 7 GHz	Backhaul	7300.000	7550.000
WLAN 2.4 GHz Channel 1	WLAN 2.4 GHz	2400.000	2420.000
WLAN 2.4 GHz Channel 13	WLAN 2.4 GHz	2460.000	2480.000
WLAN 2.4 GHz Channel 7	WLAN 2.4 GHz	2430.000	2450.000
WLAN 5 GHz Channel 100	WLAN 5 GHz	5490.000	5510.000
WLAN 5 GHz Channel 104	WLAN 5 GHz	5510.000	5530.000
WLAN 5 GHz Channel 108	WLAN 5 GHz	5530.000	5550.000
WLAN 5 GHz Channel 112	WLAN 5 GHz	5550.000	5570.000
WLAN 5 GHz Channel 116	WLAN 5 GHz	5570.000	5590.000
WLAN 5 GHz Channel 120	WLAN 5 GHz	5590.000	5610.000
WLAN 5 GHz Channel 124	WLAN 5 GHz	5610.000	5630.000
WLAN 5 GHz Channel 128	WLAN 5 GHz	5630.000	5650.000
WLAN 5 GHz Channel 132	WLAN 5 GHz	5650.000	5670.000
WLAN 5 GHz Channel 136	WLAN 5 GHz	5670.000	5690.000
WLAN 5 GHz Channel 140	WLAN 5 GHz	5690.000	5710.000
WLAN 5 GHz Channel 148	WLAN 5 GHz	5730.000	5750.000
WLAN 5 GHz Channel 152	WLAN 5 GHz	5750.000	5770.000
WLAN 5 GHz Channel 156	WLAN 5 GHz	5770.000	5790.000
WLAN 5 GHz Channel 160	WLAN 5 GHz	5790.000	5810.000
WLAN 5 GHz Channel 164	WLAN 5 GHz	5810.000	5830.000
WLAN 5 GHz Channel 168	WLAN 5 GHz	5830.000	5850.000
WLAN 5 GHz Channel 172	WLAN 5 GHz	5850.000	5870.000
WiMAX Channel 1 (lower band)	WIMAX	3510.000	3517.000
WiMAX Channel 1 (upper band)	WIMAX	3410.000	3417.000
WiMAX Channel 10 (lower band)	WIMAX	3573.000	3580.000
WiMAX Channel 10 (upper band)	WIMAX	3473.000	3480.000
WiMAX Channel 11 (lower band)	WIMAX	3580.000	3587.000

Figure 232: List of carriers

3. Select one or more carrier to import and click on **Add**, for instance the **WLAN 5 GHz Channel 112**.



Radio Unit

ID

Name: Radio Unit 1

Site: Site 1

Carrier: WLAN 2.4 GHz Channel 1

Options...

Colour:  Change...

Transp.%: 0

Antennas

ID	Tx Power	Direction	Type	Height
Antenna-240	14.8	240.00	Stella-Doradus	24.90.10.16

Buttons: New, Edit, Delete, OK, Cancel

Figure 233: Radio unit settings after adding another carrier

4. *Select now the added carrier.* Whether the "new" carrier matches to the antenna type can be seen in the pattern tab. If the carrier and the antenna type do not match, the antenna will be deactivated and the font will be changed to red.



If the carrier is changed, the antenna type of each antenna must be also adapted.



7.2.5 How to Change Radio Units faster

1. Choose **Site**→**Change Multiple**→**Radio Units**.

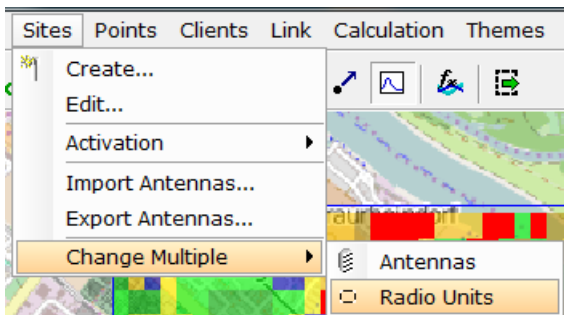


Figure 234: Change multiple radio units

2. *Select the radio unit(s) and the parameter that has to be changed.*

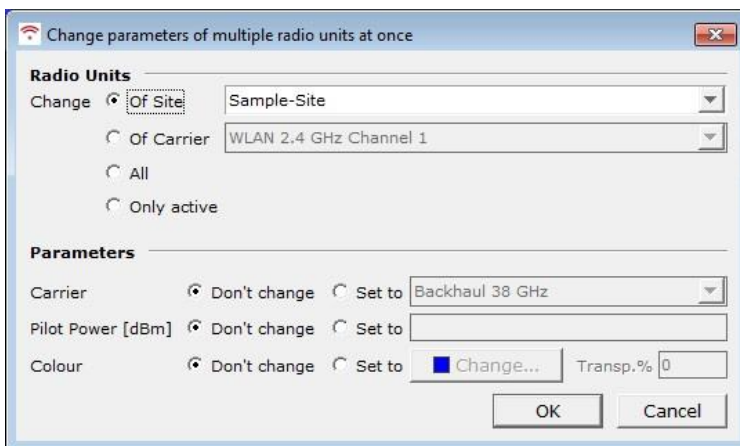


Figure 235: Change multiple radio units window

3. *Click on **OK** to save the changes.*

7.2.6 Activate or Deactivate Radio Units

Radio units can be activated and deactivated on two ways: at once or manually.



7.2.6.1 How to Activate or Deactivate Radio Units at once

1. Choose **Sites**→**Activation**→**Radio Units**→**Activate All** or **Deactivate All**.

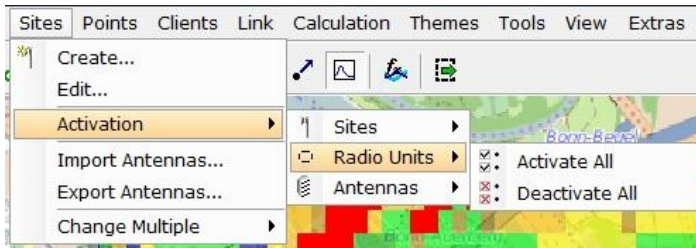


Figure 236: Activate or deactivate all radio units

This option could be useful if a calculation needs to be done only with a few radio units whereat a lot of radio units need to be deactivated.

*Simply choose **Deactivate All** and activate manually the few radio units needed.* By the time a calculation is done, all radio units can be activated with **Activate All**.



7.2.6.2 How to Activate or Deactivate Radio Units manually

1. For manually setting radio units active or inactive *simply open the Sites tab in the Project-Explorer.*

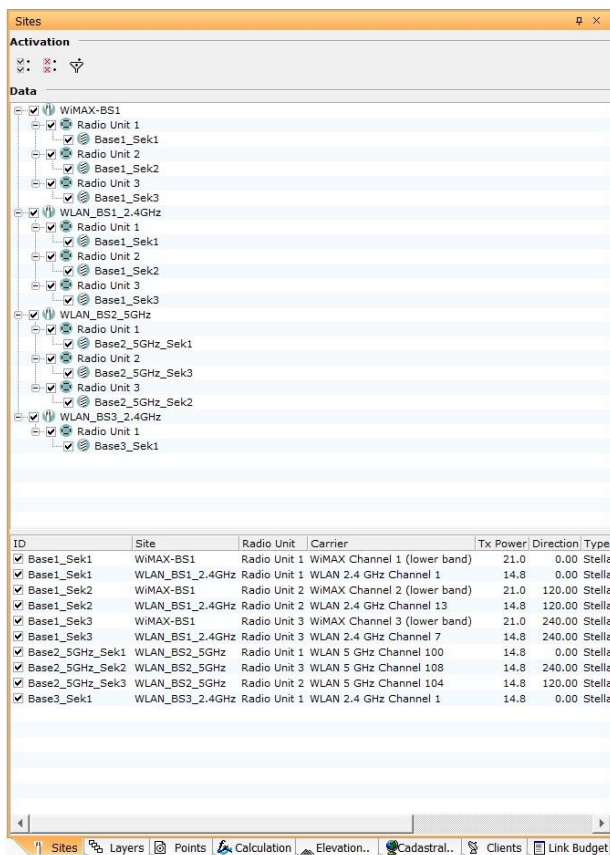


Figure 237: The sites tab

2. All radio units are listed at the top of the tab. They can be activated or deactivated by a click on the checkboxes.

7.2.6.3 How to Invert Activation

1. Open the Sites tab in the Project-Explorer and take a right click on a radio unit.
2. Select **Activation**→**Invert Activation**.

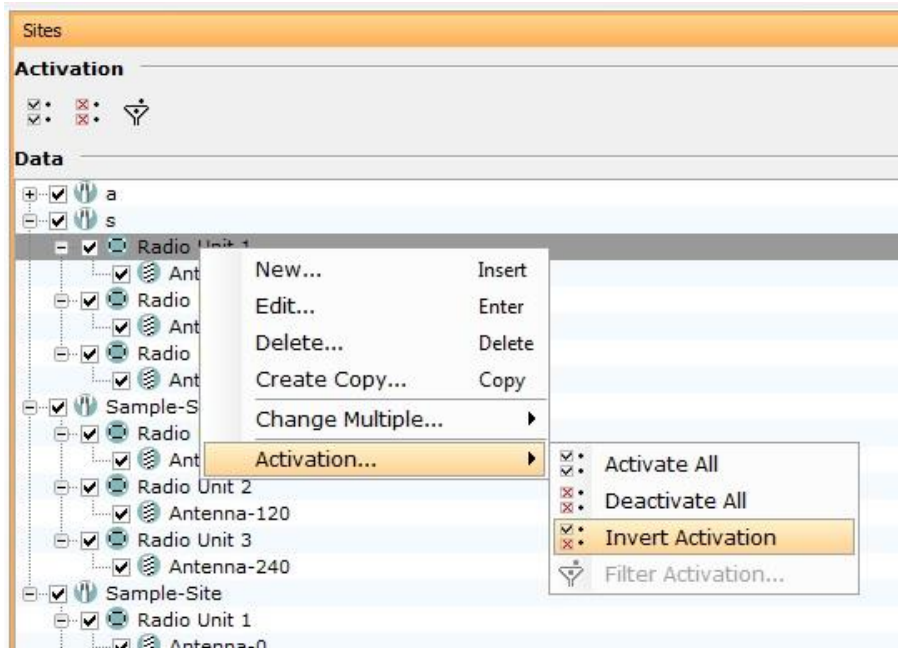


Figure 238: Site tab context menu for activation of a radio unit

3. After selecting **Invert Activation**, all active radio units are deactivated and all deactivate radio units are activated.

7.3 Sites

If all radio units and antennas are created and/or edited, sites are needed to make the antennas and radio units work in the environment.



7.3.1 How to Create Sites

Creating sites is a main aspect of WiMAP-4G. Radio units with antennas should be pre-configured before creating sites.

1. Choose **Sites**→**Create Site** and choose either **Empty Site** or **Preconfigured Site**.
If the pre-configured site was chosen, the carrier and site height can be set.

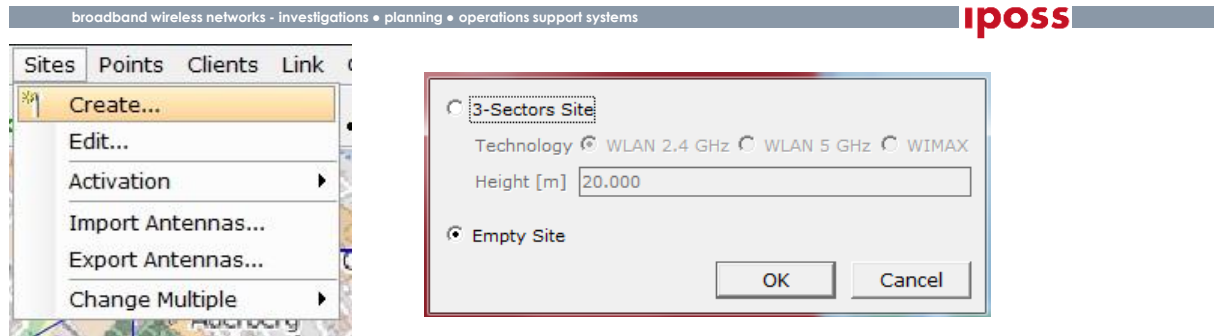


Figure 239: Create empty or 3-sector example sites



A site can also be created by right-clicking the desired point on the map and click on "Create Site".

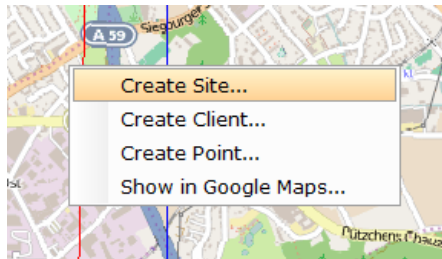


Figure 240: Create a site on the map

If there are no carrier and antennas pre-configured only an empty site can be created. In that case radio units, carriers, and antennas must be created while creating this site.



To create radio units, carriers, and antennas see the chapters 6, 7.1.1, and 7.2.10.

2. Choose a name for the new site and type in the correct coordinates where the site should be placed.

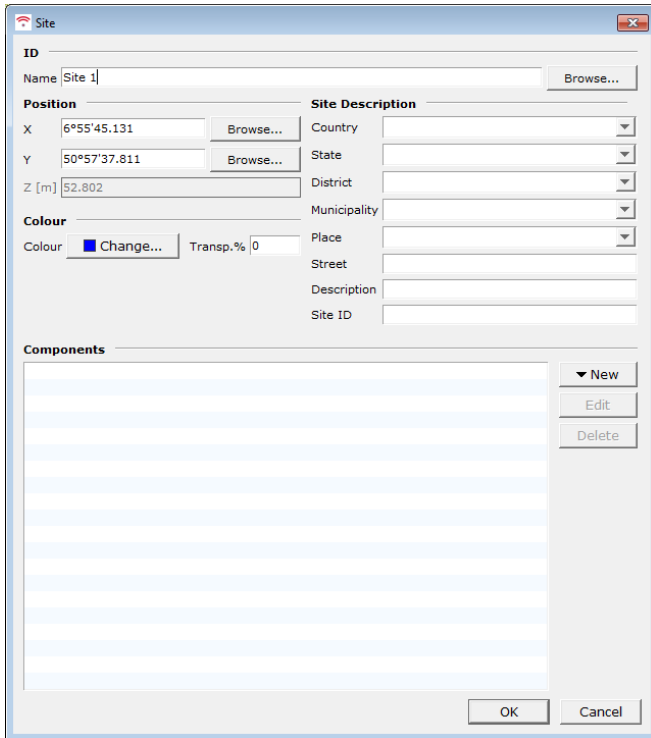


Figure 241: Create a new site

A new site has been created, now radio units and antennas must be placed to make it work.

3. Choose **New**→ **Create Radio Unit**.

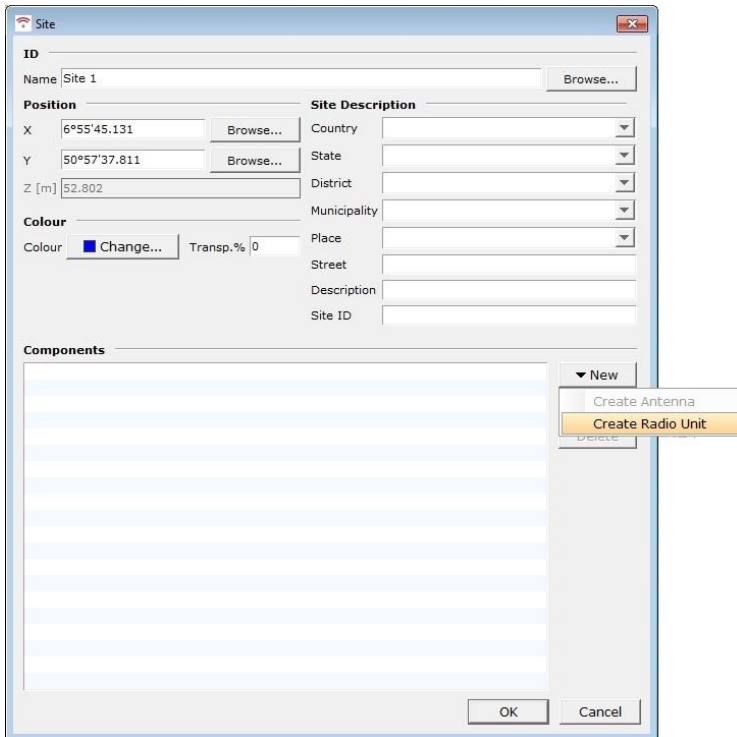


Figure 242: Create a new radio unit

4. Set the carrier type and add new antennas to the radio unit. Click on **New** for that.

Parameter of a radio unit:

- **Carrier:** Select a carrier for the antenna. If there is no carrier available for the specific purpose, *create one by clicking on **Options**→**Carriers***.



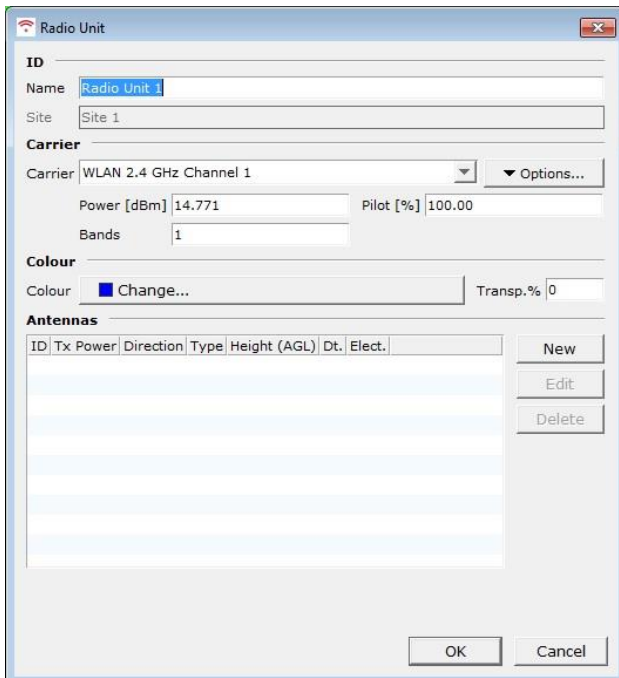
To edit carriers see chapter 6.1.

- **Power (dBm):** The power of the carrier specified in dBm.



Note that there are limitations according to the power in each country (20 dBm maximum channel power for 2.4 GHz for example).

- **Pilot Power (%)**: The pilot power of the carrier. Affects the signal radius.
Value: 1-100 %



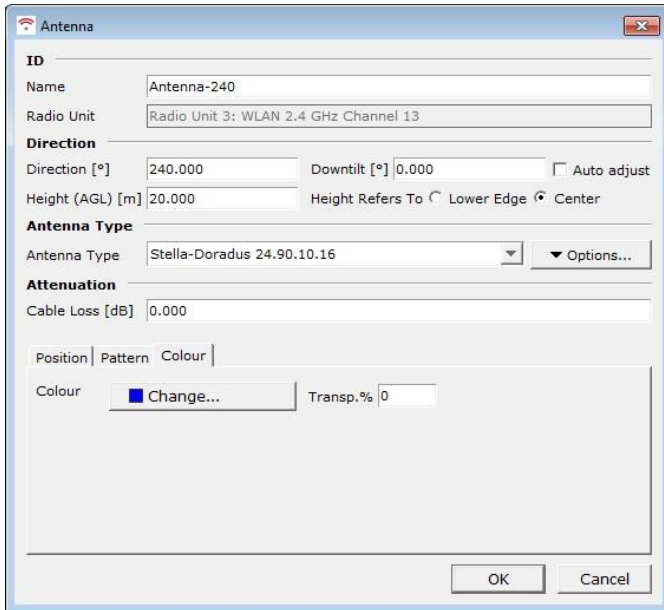
The screenshot shows the 'Radio Unit' settings window. It contains the following fields and controls:

- ID**: A section with a 'Name' field containing 'Radio Unit 1' and a 'Site' dropdown menu set to 'Site 1'.
- Carrier**: A section with a 'Carrier' dropdown menu set to 'WLAN 2.4 GHz Channel 1', an 'Options...' button, a 'Power [dBm]' field set to '14.771', a 'Pilot [%]' field set to '100.00', and a 'Bands' field set to '1'.
- Colour**: A section with a 'Colour' dropdown menu set to 'Change...', a 'Transp. %' field set to '0', and a 'Change...' button.
- Antennas**: A table with columns 'ID', 'Tx Power', 'Direction', 'Type', 'Height (AGL)', 'Dt.', and 'Elect.'. Below the table are 'New', 'Edit', and 'Delete' buttons.

At the bottom of the window are 'OK' and 'Cancel' buttons.

Figure 243: Radio Unit Settings window

5. Set the parameter of the antenna.



The image shows a software window titled "Antenna" with a close button (X) in the top right corner. The window is divided into several sections:

- ID**: Contains a "Name" field with the value "Antenna-240" and a "Radio Unit" dropdown menu showing "Radio Unit 3: WLAN 2.4 GHz Channel 13".
- Direction**: Contains a "Direction [°]" field with the value "240.000", a "Downtilt [°]" field with the value "0.000", and an "Auto adjust" checkbox which is unchecked. Below these is a "Height (AGL) [m]" field with the value "20.000" and a "Height Refers To" section with two radio buttons: "Lower Edge" (unchecked) and "Center" (checked).
- Antenna Type**: Contains an "Antenna Type" dropdown menu showing "Stella-Doradus 24.90.10.16" and an "Options..." button.
- Attenuation**: Contains a "Cable Loss [dB]" field with the value "0.000".
- Position | Pattern | Colour**: A tabbed interface. The "Colour" tab is active, showing a "Colour" field with a blue square and a "Change..." button, and a "Transp.%" field with the value "0".

At the bottom of the window are "OK" and "Cancel" buttons.

Figure 244: Add antennas to the radio unit

- Parameter:
 - **Height** (Above ground level): Height of the antenna
 - Set **Height Refers To** whether to **Lower Edge** or **Center**. This is important for a hilly environment.
 - **Direction**: Direction of the antenna. If the antennas has a 360° angle, the direction does not need to set to a specific value. Note that signals that use the same channel interfere each other when they overlap.
Value: 0-360°
 - **Downtilt**: Set the downtilt of an antenna. This is important for interconnection or hilly environment.
 - **Auto-Adjust**: Can be set to let the program manage the downtilt automatically.
Value: 0-360°
 - **Cable Loss**: Cable loss for the antennas. The exact value can be obtained from the manufacturer of the antenna.
 - **Antenna Type**: Choose the antenna of your choice. Make sure the antenna correspond to the conditions. A 5.4 GHz antenna may not be used for a 2.4 GHz carrier.

At the bottom of the window is a short list containing four entries. Proper technology pattern is of particular importance. If it is highlighted, the antenna does not achieve the requirements for the current configuration.

All Patterns: 1
 Proper Technology Patterns: 35.60.8.18.V (No Match)
 Proper Polarization Patterns: 35.60.8.18.V

Figure 245: Invalid antenna pattern

Change either **Antenna Type** or **Carrier Type**.

If there is no antenna available for the specific scenario, it can be created by *choosing* **Option→New** or **Options→Antenna Types→New**.

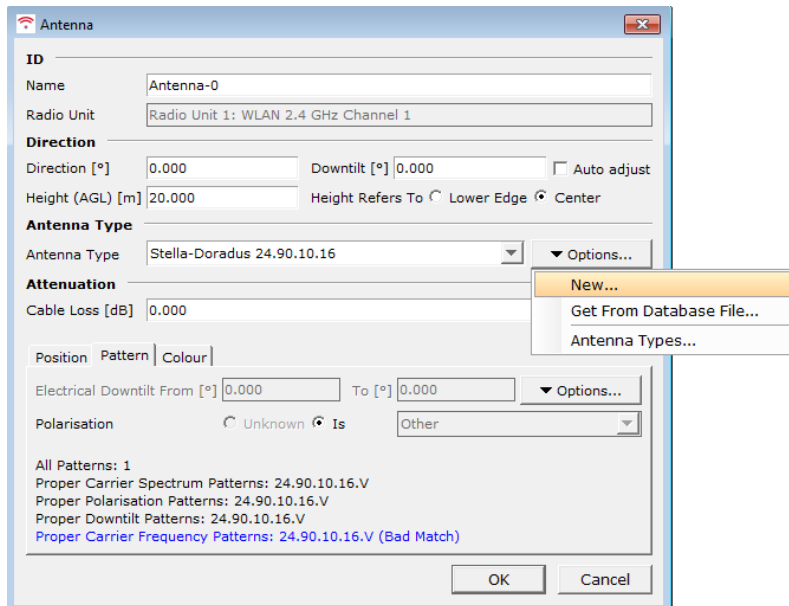


Figure 246: Create a new antenna-type



A short introduction how to create antennas can be found in chapter 7.1.1.1

- **Antenna Name:** Choose a name for the antenna. This name appears in the Project-Explorer and is useful to locate antennas.

There are two more categories at the bottom of the window:

- **Pattern:** There is no need to edit those, because a pattern for the antenna is imported already.
- **Position:** Edit the position of the antenna. If there is no good reason to change this, the antenna should remain in the position of the site.

Click on **OK** to create and place the antenna at the specific radio unit. Click again on **OK** to create and place the radio unit at the selected site.

broadband wireless networks - investigations • planning • operations support systems

Site

ID

Name Site 1 Browse...

Position

X 7°05'46.005 Browse...

Y 50°42'23.033 Browse...

Z [m] 168.468

Site Description

Country ▼

State ▼

District ▼

Municipality ▼

Place ▼

Street

Description

Site ID

Colour

Colour ■ Change... Transp.% 0

Components

- Radio Unit 1
 - Antenna-0

▼ New

Edit

Delete

OK Cancel

Figure 247: The created antenna in the list

- If all needed antennas have been created, *click on **OK** to place the site on the map.*



Figure 248: The created site on the map



7.3.2 How to Edit Sites

- Right-click the desired site on the map or select the site in the Sites-tab and choose **Edit**.*

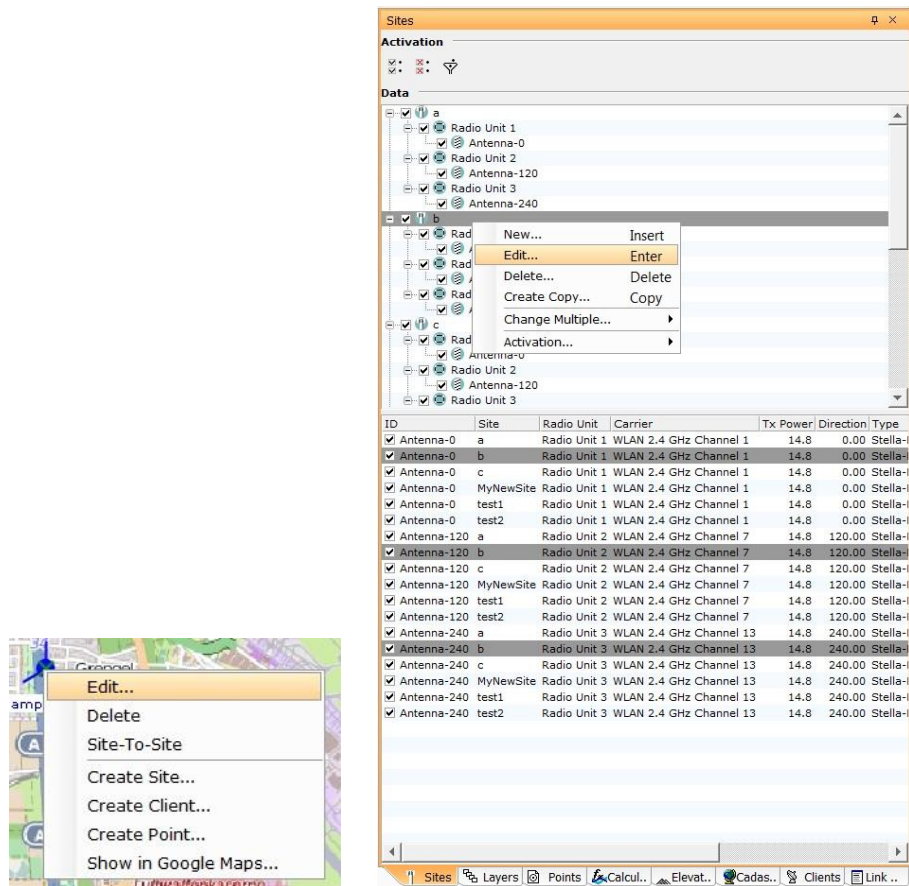


Figure 249: Select the site by right-click on the map or in the sites tab.

2. The sites settings window will be opened and offering access to site-description and antennas.

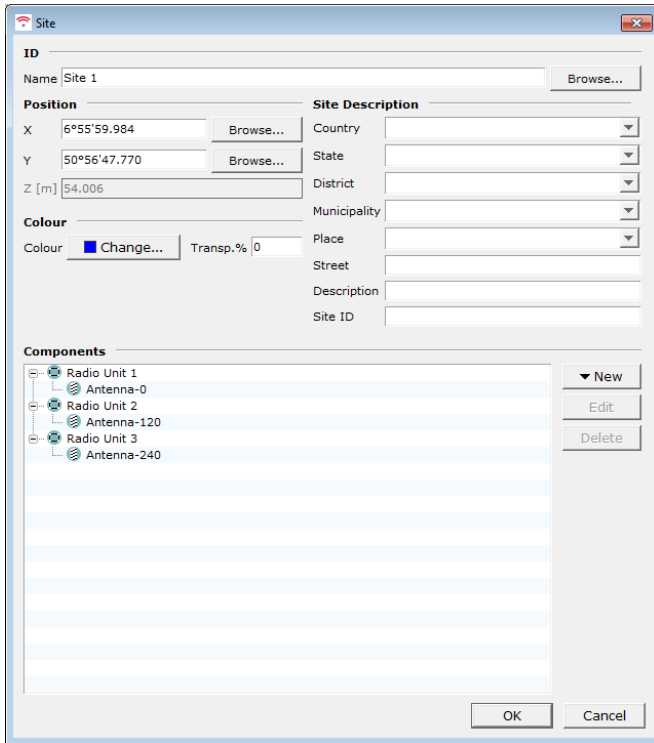


Figure 250: Edit the site and click OK to save changes.

3. Antennas and radio units can be edited by choosing **Edit function**.



A short introduction how to edit antennas and radio units can be found in chapter 7.1.2.1 respectively in chapter 7.2.2.

4. Click on **OK** to save changes.

7.3.3 How to Copy Sites

1. Right-click the desired site in the Sites-tab and choose **Create Copy**.

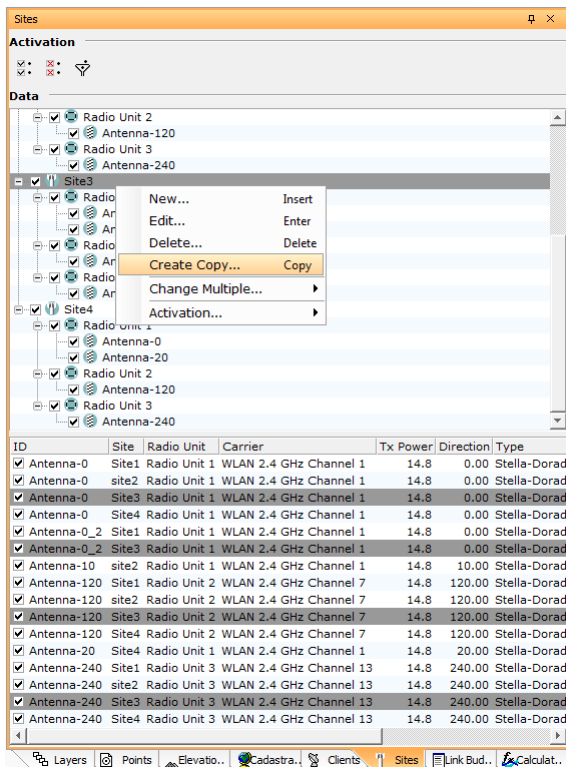


Figure 251: Select the site by right-click in the sites tab

2. The sites settings window will be opened and offer access to site-description, radio units and antennas.

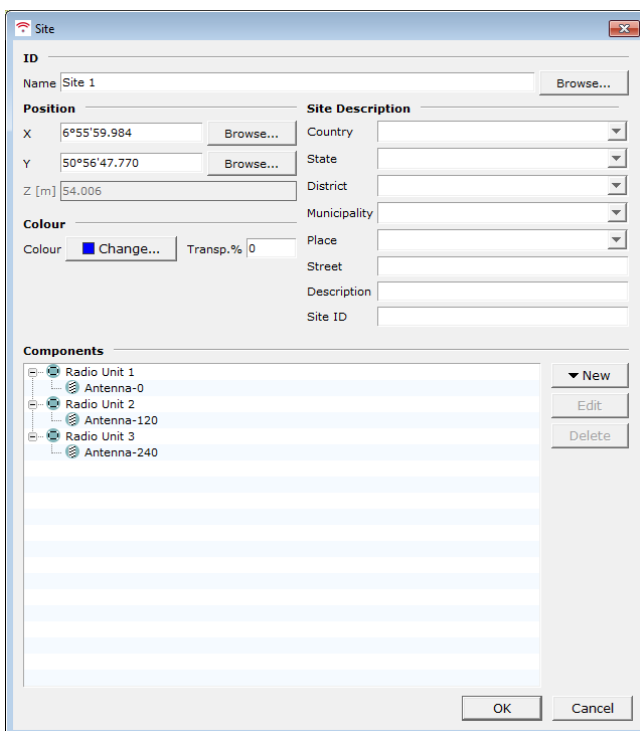


Figure 252: Site Settings window

3. *Edit the site settings.*
4. Antennas and radio units can be edited/removed by choosing the antenna or radio unit and clicking on **Edit/Delete**.



A short introduction how to copy antennas and radio units can be found in chapter 7.1.3 respectively in chapter 7.2.3.

5. *Click on **OK** to save changes.*

7.3.4 Activate or Deactivate Sites

Sites can be activated or deactivated. This may be important if the user wants to make a calculation that does not include all antennas. A lot of antennas need a long time to calculate and if only a little detail has been changed, the user does not want to make a two hour calculation to see the mistake.

There are two methods to activate or deactivate sites: at once or manually.



7.3.4.1 How to Activate or Deactivate all Sites at Once

1. Choose **Sites**→**Activation**→**Sites**→**Activate All** or **Deactivate All**.

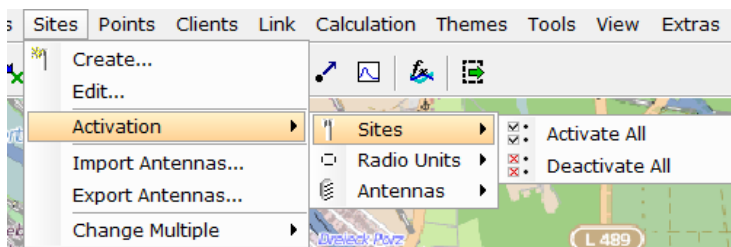


Figure 253: Activate or deactivate all sites

2. *As an alternative, use the icons on tool panel in the **site tab** of the **Project-Explorer**.*

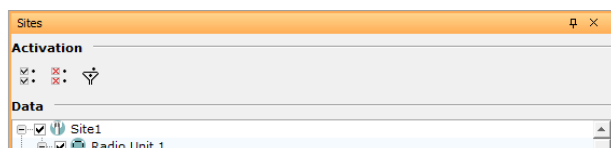


Figure 254: The tool panel of sites tab

This option could be useful if a calculation needs to be done only with a few sites whereat a lot of sites need to be deactivated.

Simply choose **Deactivate All** and activate manually the needed sites. By the time a calculation is done, all sites can be activated with **Activate All**.



7.3.4.2 How to Activate or Deactivate Sites Manually

1. To set sites active or inactive manually *simply open the **Sites Tab** in the **Project-Explorer**.*

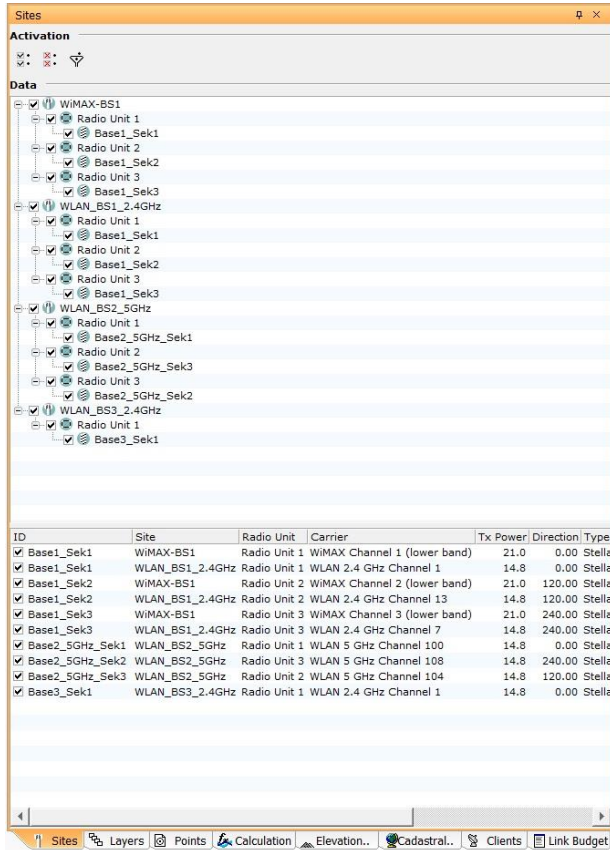


Figure 255: The Sites tab

2. All sites are listed at the top of the tab. They can be activated or deactivated.

8 Points

Points have a lot in common with clients but they are a little bit different. Points can be placed everywhere on the map. They represent for example potential customers or measurement points for the wireless solution created with WiMAP-4G. There are less calculation possibilities for points than for carriers. A point should be set if there is no further information on a client about what technique he uses.

8.1 Measurement Points

A measurement point is defined by coordinates and other parameters like *Power Level* or *SNR*. This used measurement point is for radiowave measurement like WLAN or WiMAX. The category *Measurement* is an example for a point category that can be used to define a measurement point. Measurement points can be imported from a measurement data file in .csv format, see Figure 256 for an example. Each point must have a minimum of attributes like *Name* and *Coordinates*.



If no suitable converter is available, contact us at info@brown-iposs.eu.

Measurement_48u3.csv									
	Name	Power	SNR	Carrier	Height	X	Y	Z	Colour
1	p01_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
2	p02_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
3	p03_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
4	p04_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
5	p05_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
6	p06_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
7	p07_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
8	p08_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
9	p09_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
10	p10_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
11	p11_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
12	p12_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
13	p13_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
14	p14_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
15	p15_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
16	p16_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
17	p17_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		
18	p17_SID105_AP1	-86	8	WLAN_5GHz		6.776615	51.21928667		

Figure 256: Supported .csv file with measurement information

A measurement file can be imported by a normal import of points (look at 8.5.3). But there is a little difference. Each measurement point gets his own point, so that one point can overlap another point. After an import it should be checked if the imported carrier is existing.

If this carrier does not exist, the carrier must be created. With the function **Points→Edit multiple...** (look at 8.3.3) it is also possible to change the carrier to an available carrier.

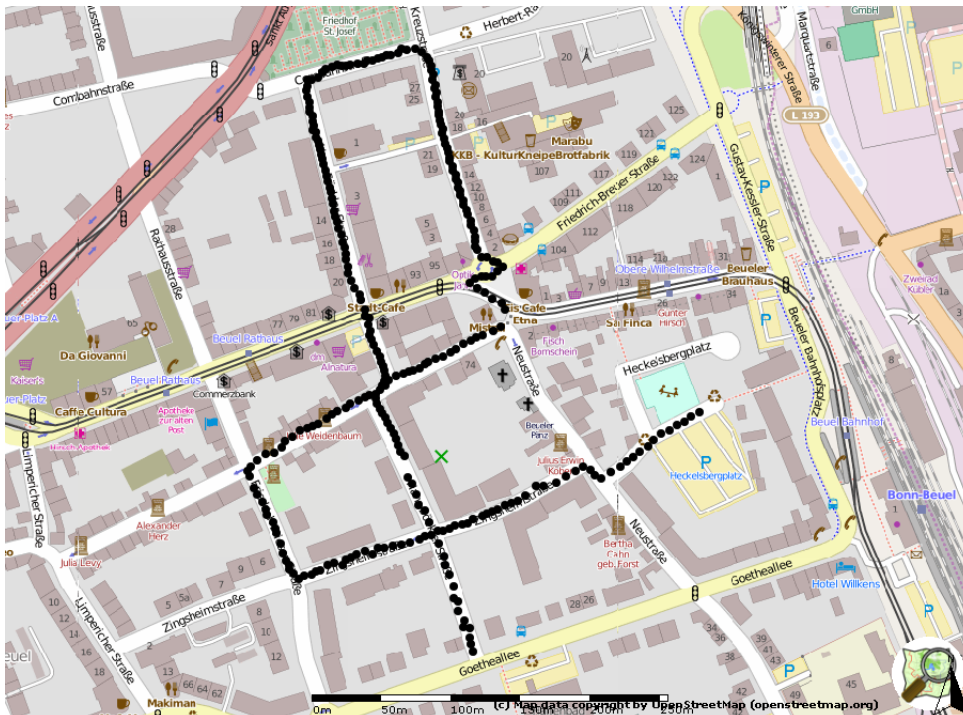


Figure 257: Measurement points from a measurement without colour information

If there is no colour information in the .csv file all points are black. The colour can be set by the functions coverage and/or visualisation (look at 8.6.2 and 8.6.3).

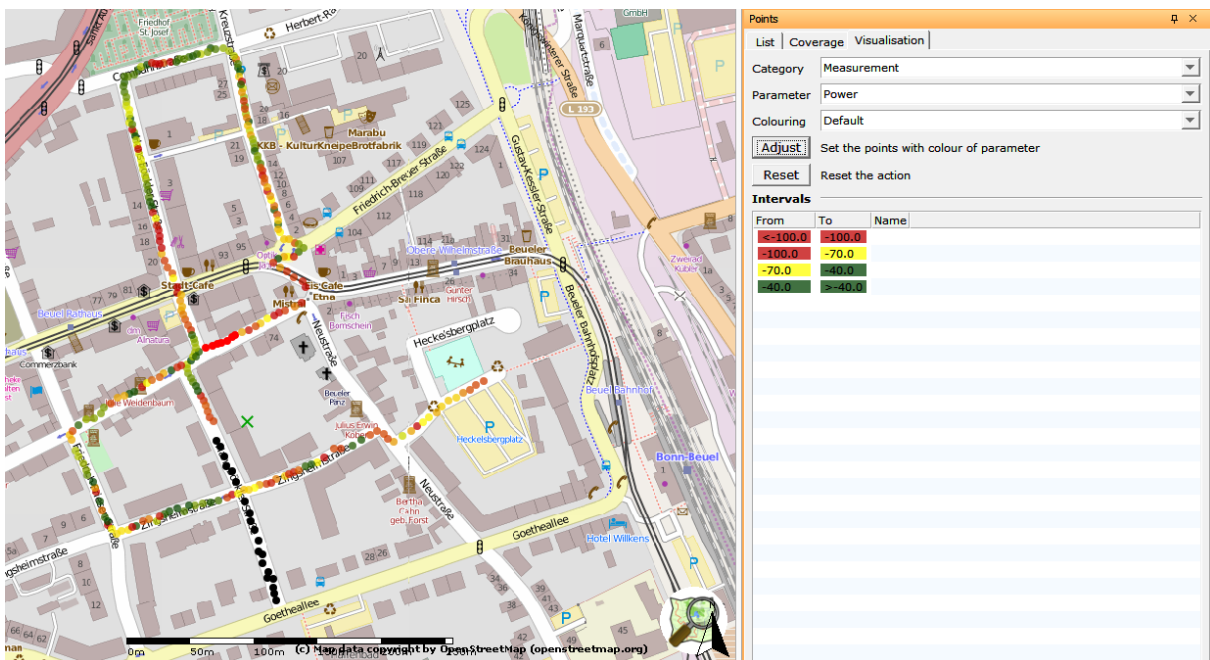


Figure 258: Measurement points from a measurement coloured by visualisation

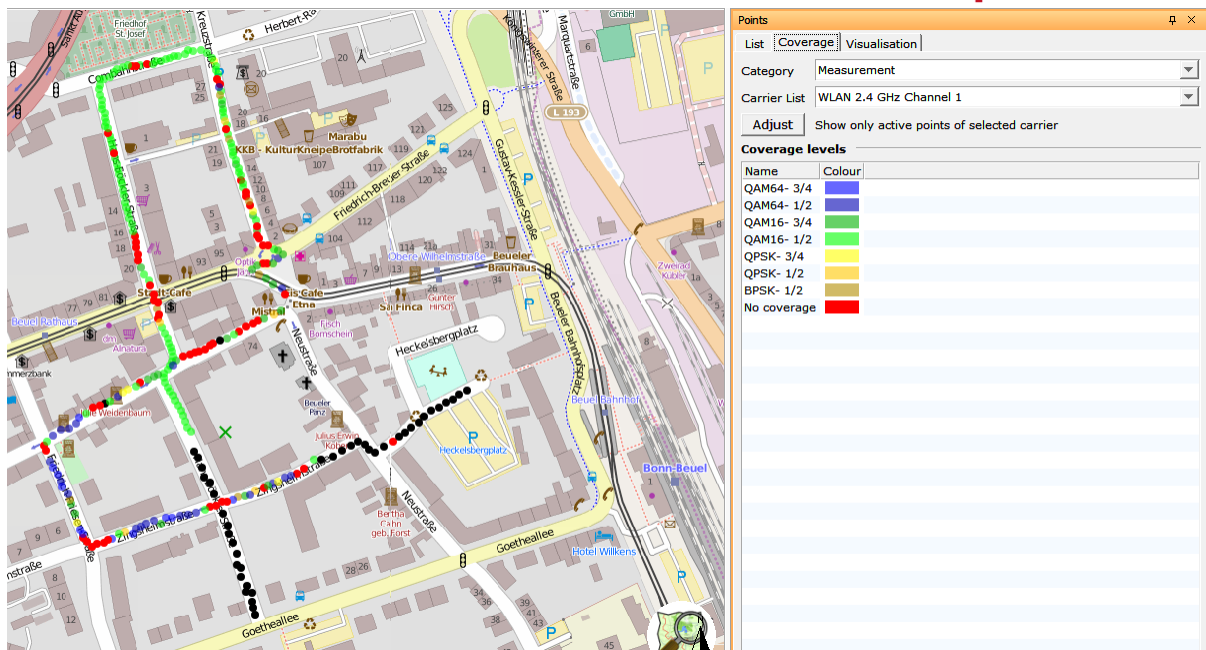


Figure 259: Measurement points from a measurement coloured by coverage

8.2 Point Categories

Point categories are essential to create points. Before creating a point on the map, the point category needs to be created or edited for specific needs. Add all columns that can be described while a point is created. If the height of the customer antenna is known, *add a column of type **Meter** and name it **Height*** for example.

All category parameter types that can be added:

- C/I
- Data rate
- Degree
- Field strength
- Meter
- Ordinal
- Power level
- Text
- URL
- X-coordinate
- Y-coordinate

The default category *Measurement* is a category that has the following default parameter: *Power Level, SNR, Carrier and Height*. But the parameter can be extended with e.g. Field Strength, Data rate and more.

The demo project "Munich" has the category *Potential Customer* with the parameters Height and Y/N (Text). This category can be added also to other projects by importing it from the demo project or by defining it manually.



8.2.1 How to Edit Point Categories

If a new value type for a point is necessary, the point category has to be edited first.

1. Choose **Points**→**Edit Categories**.

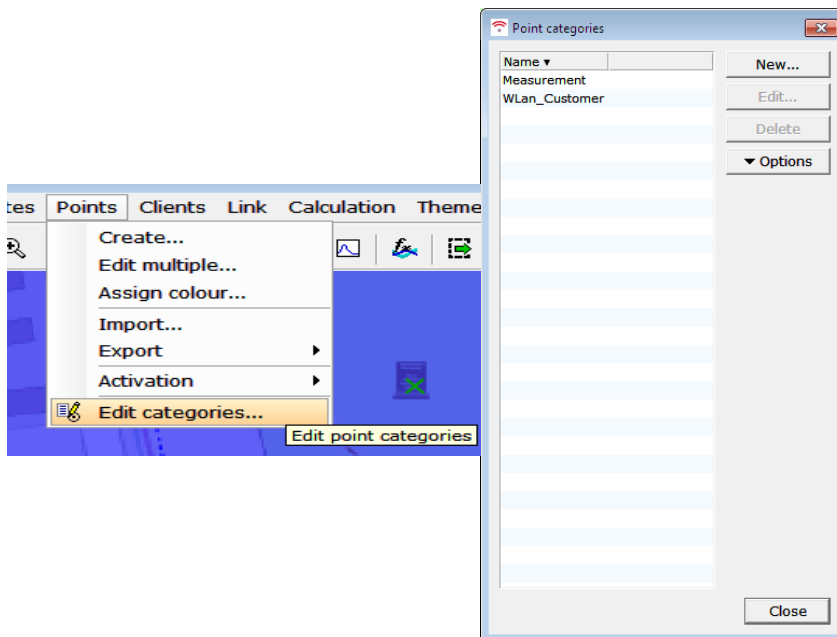


Figure 260: Edit point categories

2. Choose the category that needs to be edited and click on **Edit**. The point category window opens and columns can be added, edited, deleted or moved up and down. When all changes are done, click on **OK** to save the changes.

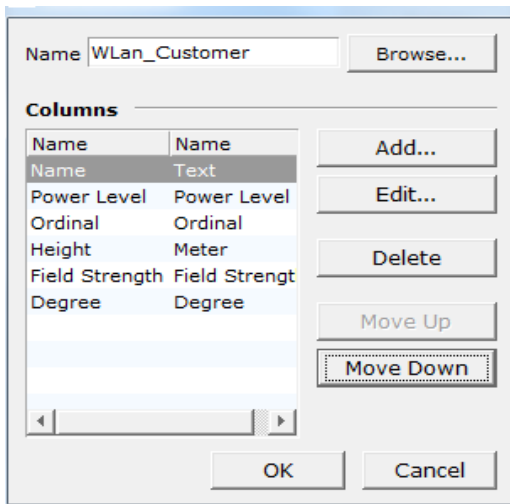


Figure 261: Point category windows



8.2.2 How to Create a Point Category

1. Choose **Points** → **Edit Categories**.

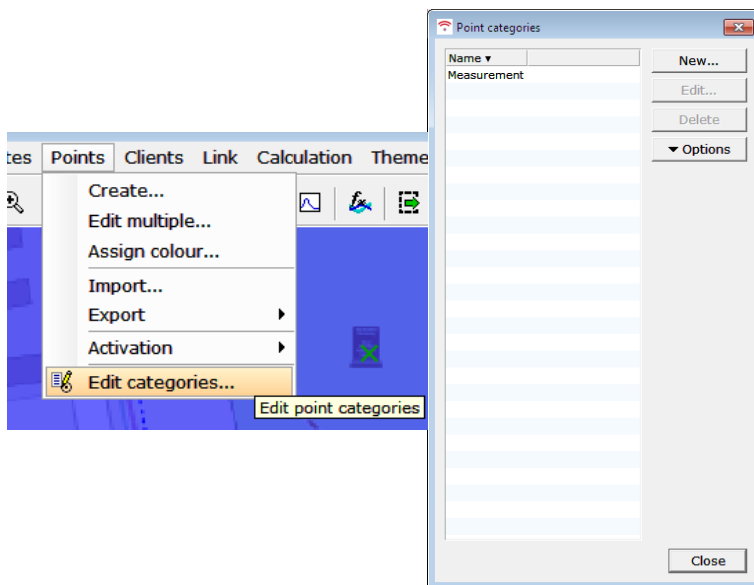


Figure 262: Create new point categories

2. One point category is preconfigured. You can use or edit it or create a new one.
To create a new point category, click on **New**.

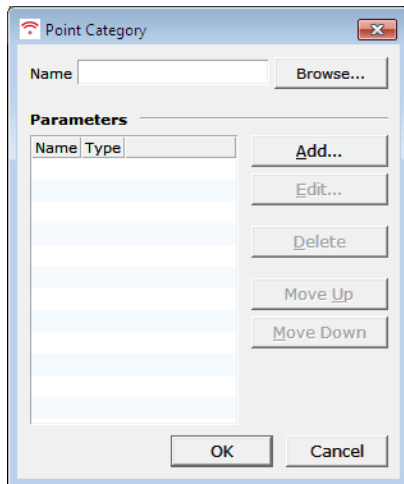


Figure 263: A new point category

3. Choose a name for the point and click on **Add** to create new columns for this point.

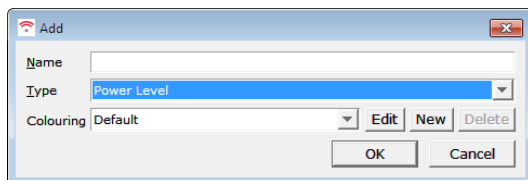


Figure 264: New type and name

In case there are no special circumstances, it is recommended to choose the type as the name.

Add all desired columns and press **OK** to save the point category.

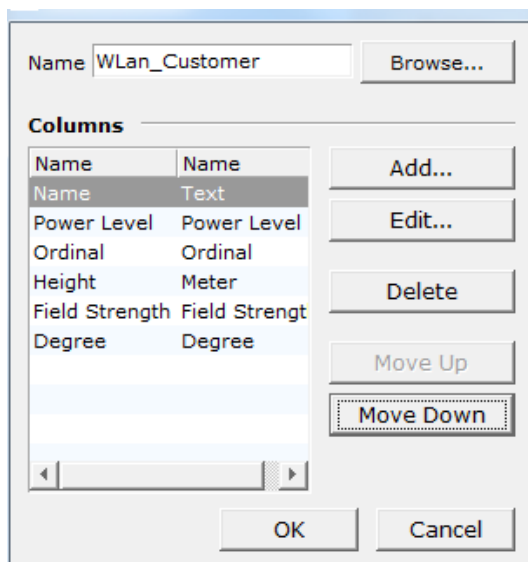


Figure 265: Save the new category

8.3 Create Points

When all point required categories are created, a point can be set.



8.3.1 How to Create Points

1. There are three possibilities to create points:

- Choose **Points→Create**.

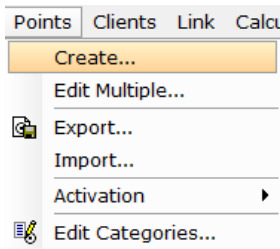


Figure 266: Create points from the menu

- Right-click the desired position on the map and choose **Create Point**.

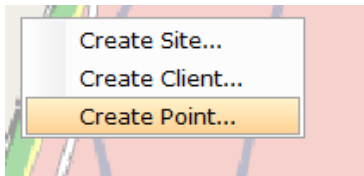


Figure 267: Create a point on the map

- Choose the **point tab** in the **Project-Explorer**, right-click there and choose **New**.

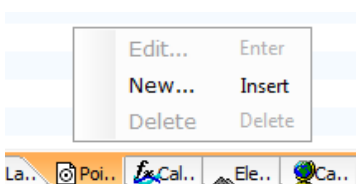


Figure 268: Create a point in the points tab

2. Choose a *point category* in the appearing window and click on **OK**.

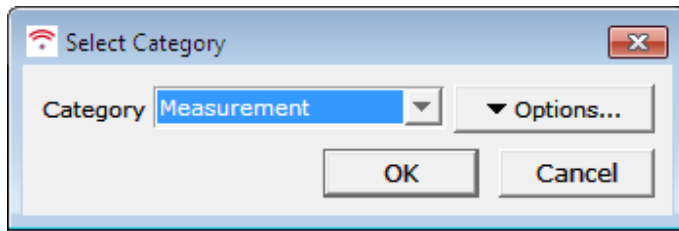


Figure 269: Choose a category

If there is no point category, it needs to be created. This can be done by *choosing Options→New*.



A short introduction how to create point categories can be found in chapter 8.2.2

3. The next window shows all the columns created in the chosen point category. Feel free to fill as many as you can. The X/Y coordinates can be manually set to make sure the point position hits the actual position of the customer exactly. If the coordinates are only known from a different coordinate system, *press Browse* to set them correctly. Please note that **Carrier List** appears as soon as a column **Carrier** exists in the point category. While changing the text in the column **Carrier**, the suitable carrier will be automatically searched in the **Carrier List**. If nothing can be found, it is marked in red and an error message is issued. A check whether the project has sites with carrier is included.

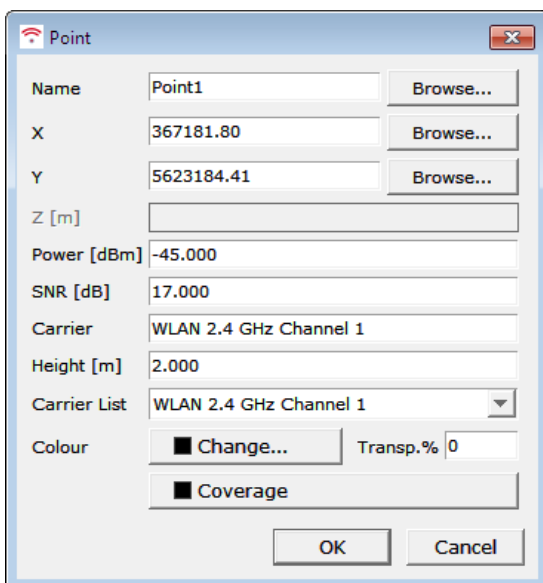


Figure 270: Fields for creating a point

If everything is done, *press **OK** to create the point.*



Figure 271: The new point appears on the map.



8.3.2 How to Edit Single Points

Sometimes points need to be edited because there may be more information about the customer available. If this includes a new type of value, edit the point category first and edit the point afterwards.

1. There are two possibilities to edit a single point:

- *Right-click on the point on the map and choose **Edit**.*

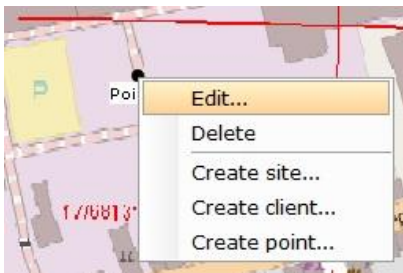


Figure 272: Editing a point on the map

- *Right-click on the point in the Project-Explorer and click on **Edit**.*

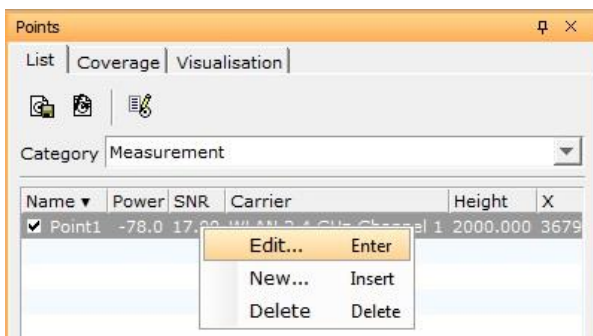


Figure 273: Editing a point with the help of the points tab

The points in the point tab are shown by category. The right point category needs to be selected to show the desired point in the list.

2. In the appearing window, *edit the columns of the point and click on **OK** to save the changes.*

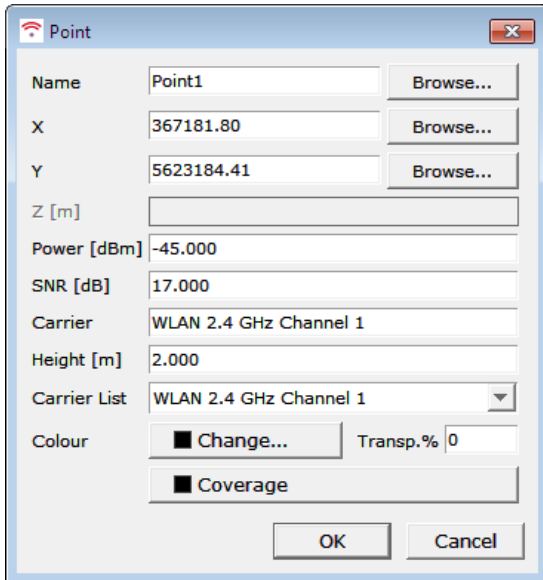


Figure 274: Edit the desired fields



8.3.3 How to Edit Multiple Points

Points can also be edited in groups, which means that a value can be set for all members of a point category. This could be very useful if a value of a whole group has to be changed, for example, the power level.

1. Choose **Points**→**Edit Multiple**.

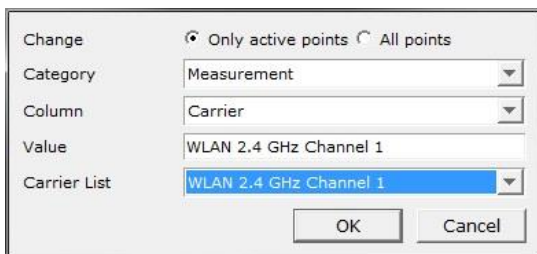
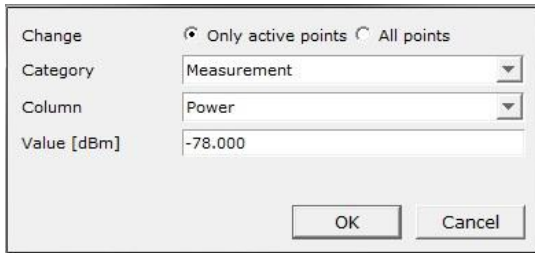


Figure 275: Edit multiple points at once

2. *Choose the desired point category and choose either all points to be edited or only active points. Choose a column that should be edited for all members of the point category and insert a new value. Click on **OK** to save the changes.*



Change ☒ Only active points ☐ All points

Category: Measurement

Column: Power

Value [dBm]: -78.000

OK Cancel

Figure 276: Choose column and value

8.4 Point Activation

Points can be active or inactive as well as antennas, sites and clients. This can be beneficial, for example, for making a calculation.



8.4.1 How to Activate or Deactivate Points

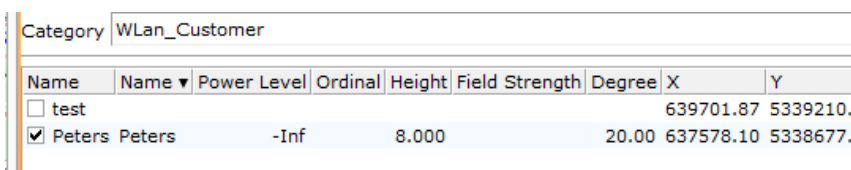
Points can be activated or deactivated in different ways depending on the user.

Fast way:

1. Choose **Points→Activation** and one of these options:
 - **Activate all:** All points of a chosen point category will be set to active.
 - **Deactivate all:** All points of a chosen point category will be set to inactive.
 - **Invert activation:** All active points will be inactivated and all inactive will be activated (point category needs to be chosen).
 - **Rectangular activation:** After choosing a point category, the four vertices of a rectangle can be altered to coordinates and all points inside will be activated.
 - **Circular activation:** After choosing a point category, both center coordinates and radius can be set and all points inside the circle will be activated.
 - **Filter activation:** Points can be activated based on a filter with the following parameters: Power Level, SNR and Carrier.

Slow but precise way:

2. All points of the specific category are shown in the **point tab** of the **Project-Explorer**. They can be activated or deactivated by checking or unchecking them.



Category: WLAN_Customer								
	Name	Power Level	Ordinal	Height	Field Strength	Degree	X	Y
☐	test						639701.87	5339210.
☒	Peters Peters	-Inf		8.000		20.00	637578.10	5338677.

Figure 277: Slow way to activate/deactivate points

Alternative way:

3. All points can be activated using the icons on the tool panel in the **points tab** of the **Project-Explorer**.

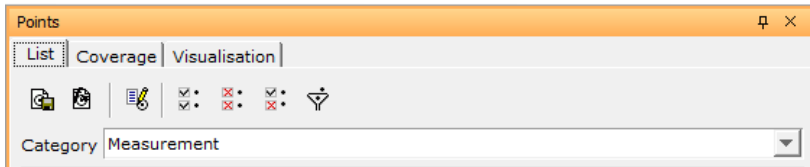


Figure 278: The tool panel of points tab

8.5 Export and Import of Points

Points can be imported and exported. This could be useful if these points are used in other projects or if there were other projects with a lot of already constructed points. It is not necessary to create them twice. Furthermore it is necessary to import or to export the measurement data.



8.5.1 How to Export Points as .csv file

1. Choose **Points**→**Export**→**As CSV...** to open the export window.

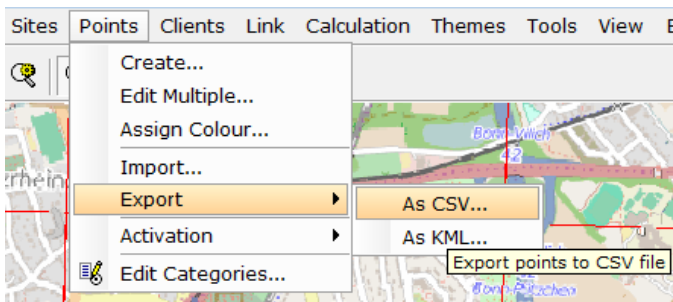


Figure 279: Export points as .csv file

2. Choose the **point category** that should be exported and set a **decimal separator**. This decimal separator is used in the created file to separate numbers. The null value will be used for lacking point columns and hence is only useful to convey readability of the created .csv file.

*Choose a filename and path for the created file. If the file path is unknown, click on **Choose** to open the explorer browser window. Then select the parameters of **point category** that are needed to export. If everything is done, click on **OK** to export all points of that **point category**.*

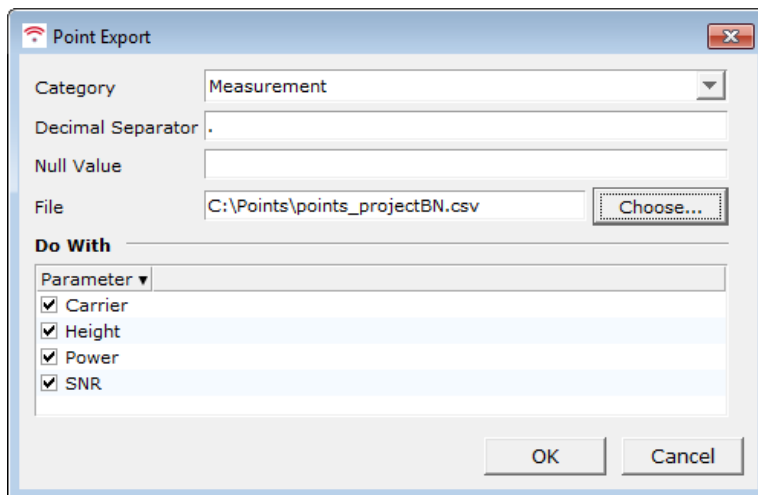


Figure 280: Export points dialogue window



Note that not all symbols are supported. An unsupported symbol prevents the user from importing a .csv-file to another project. It is always secure to choose "999".

3. The created .csv file can be found at the chosen file path.

8.5.2 How to Export Points as .kml file

1. Choose **Points→Export→As KML...** to open the export window.

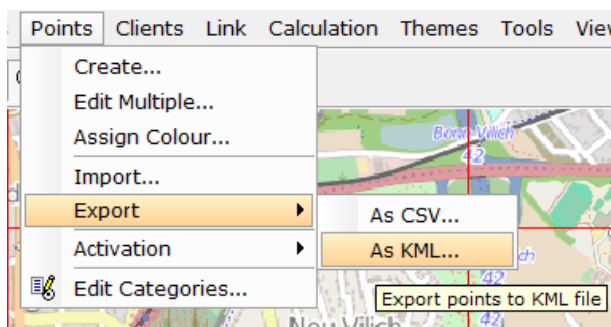


Figure 281: Export points as .kml file

2. Select the path where the .kml file should be saved.

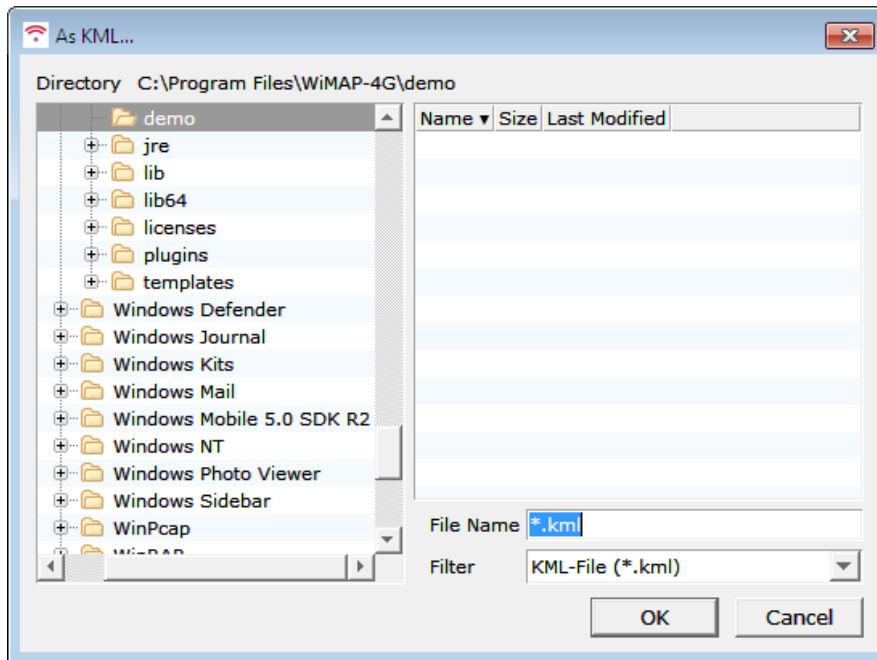


Figure 282: Select path for export as .kml file

3. The export of points is finished and the .kml file can be used in other programs like Google Earth™.

8.5.3 How to Import Points



1. Choose **Points**→**Import** to open the import window.

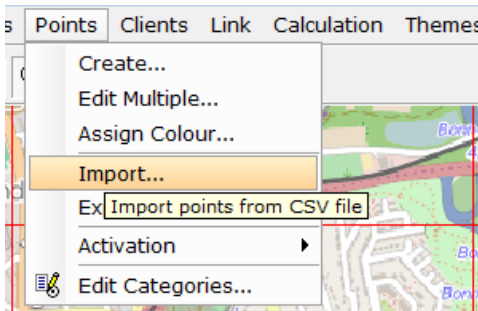


Figure 283: Import points

2. Choose **Existing Category** that already exists in the actual project or choose **New Category** to create the new point category. The decimal separator should not be edited. The null value can be edited to set columns to a specific value with none exported value. Choose the file and click on **OK** to start the point import.

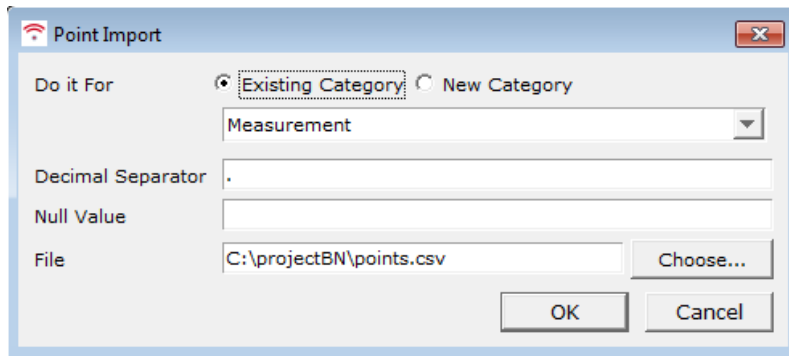


Figure 284: Import points dialog window

3. The types of column which are not recognized by import are highlighted in red. Double-click on the warning field and set the appropriate type of parameter. Then click on **OK** to import the points.

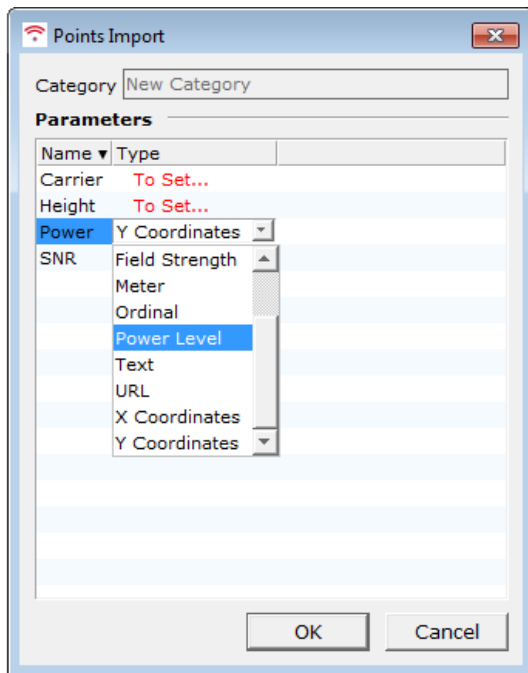


Figure 285: Set the types of parameters

4. The imported points are shown on the map now.

8.6 Points colour assignment

The colour of a point can be changed manually for a better overview. With the functions visualisation and coverage the colour can be set based on a parameter, for example *Power*, *SNR* or *Coverage*.



8.6.1 How to Change the Colour of a Point manually

1. Open the edit-window of a point like described in 8.3.2 for edit a single point or open the menu **Points→Assign colour** to edit multiple points.
2. Select **Colour→Change...** for editing only active points (left), for editing all points (right), select **Colour→Change manually** and click on **Change....** Now a window with a colour palette will be open.

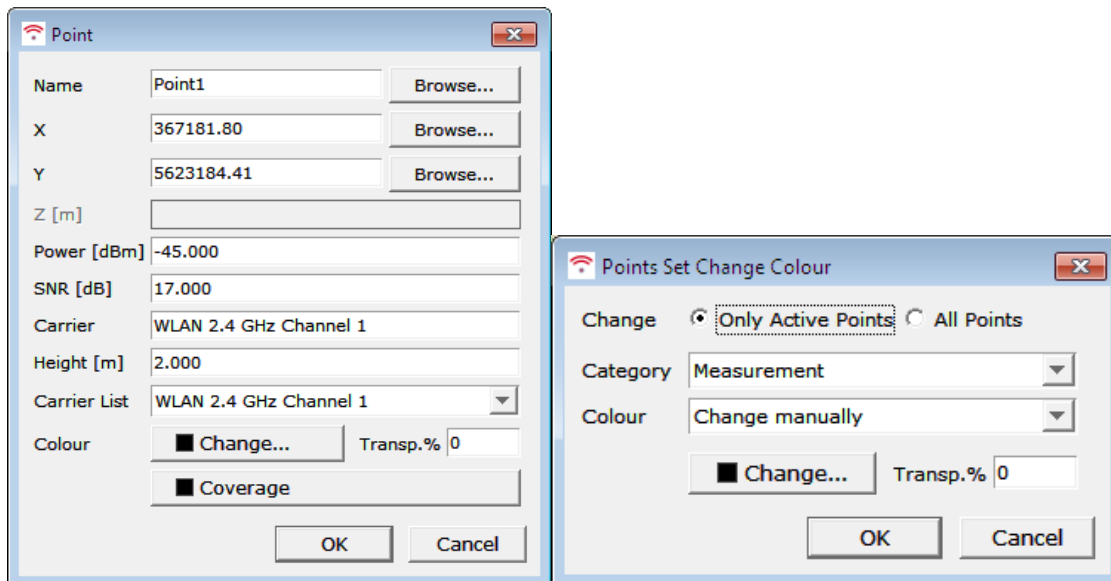


Figure 286: left: Edit single point | right: Edit multiple points

3. Click on **OK** to close the colour palette and to apply the selected colour. Click on **OK** again to close and apply the settings in the edit window.

8.6.2 Change Colour of Points temporary by Visualisation tab

The *Visualisation tab* changes the colour of points based on the category, parameter and the colouring. In this tab only those parameters can be selected which have colour as a trait.



The colouring of a parameter can be set at *Edit categories→Edit a selected category→Edit a selected Parameter→Colouring→Edit or New.*

8.6.3 Change Colour of Points by Coverage tab

For colouring with the coverage each point must be activated for this function. This works by editing a point (*Edit→Colour→Coverage*) or by activating multiple points by *Points→Assign*

colour→Colour→Adopt with coverage (like in Figure 248). In the points tab coverage can show the colour levels.



8.6.4 Change Colour of Points according to Theme Calculation

One result of theme calculation is needed to colour the points.

1. Make any theme calculation (like in 10.6.1, 10.7.1, 10.8.1, 10.9.1, 10.10.1)
2. Choose **Themes→XXX→Points Colour**

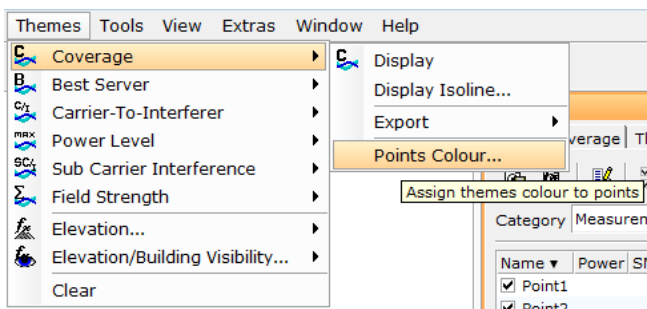


Figure 287: Choosing Points Colour from menu

3. Select **Points of Category/All/Active** and click **OK**.

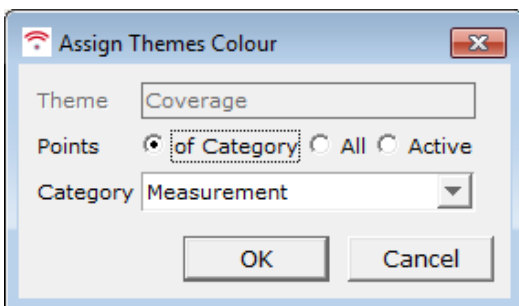


Figure 288: Points Colour Setting

8.7 Clients and Points

It is possible to convert clients to points or to create clients from points. This can be used if the user does not want clients on his project anymore and wants to convert them to simple points. This can also be a benefit for the overview. As mentioned, there is a small area with about 100 clients. For a better overview it is necessary to convert the clients temporarily otherwise all associated lines would simply flood the screen. The other way is to convert points to clients in a future stage of the project.



8.7.1 How to Create Clients from Points

1. Choose **Clients**→**Convert from Points**.

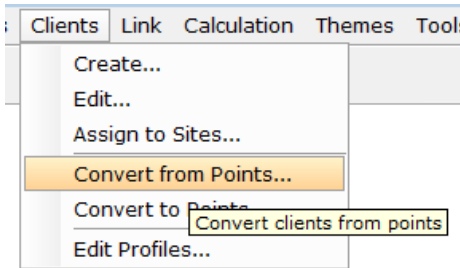


Figure 289: Convert points to client from menu

2. Now, there are a few settings that need to be done to create clients from points. At first, it should be decided whether all points or only active points should be converted. At second, site and client profile assignment should be set.
*Choose the option **Nearest with** if the converted objects should be linked to the next obvious site or choose the desired site from list, with which should be linked.*
Please note that site list will be created automatically as soon as the client profile is known. If the profile editor is empty, add new profiles by clicking on **Options**→**New** or **Options**→**Client Profiles**.

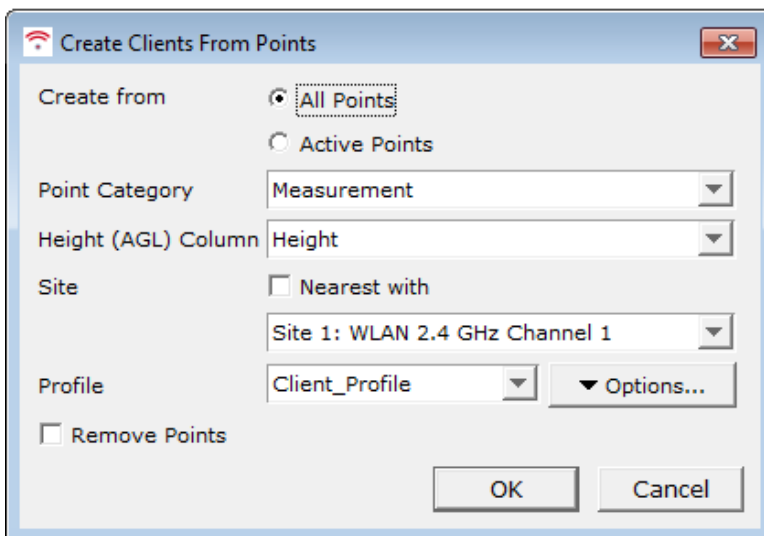


Figure 290: Create clients from points settings

Converting is only possible with a certain point category, not with all. Next thing to choose is the height column from the chosen point category. So if there are a few columns from type "meter", *choose the one that describes the height above ground level*. Before finishing the conversion, *choose the points to be deleted after creating the clients or still to occur afterwards*.

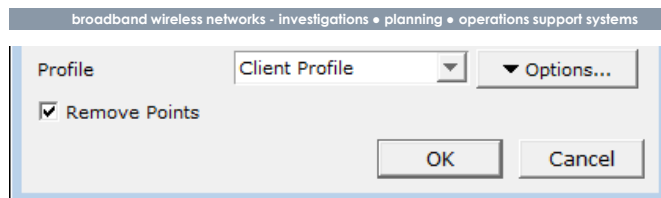


Figure 291: Option Remove Points

3. Click on **OK** to convert all the chosen points to clients.

If everything worked out, the points will be clients and will show a blue dashed line in the chosen site.

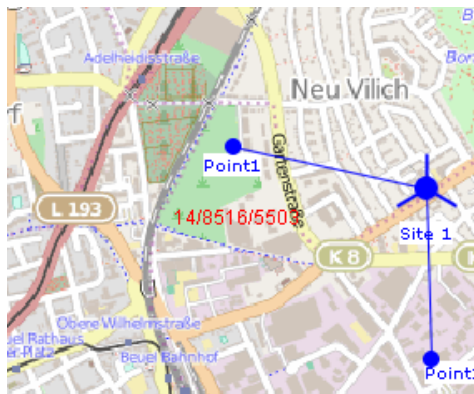


Figure 292: The created clients appear on the map

Clients						
ID	Site	Carrier	Profile	Height (AGL)	Coverage	Power
☒ Point1	Site 1	WLAN 2.4 GHz Channel 1	Client Profile	0.000		
☒ Point2	Site 1	WLAN 2.4 GHz Channel 1	Client Profile	0.000		

Figure 293: The created clients on clients tab



8.7.2 How to Convert Clients to Points

1. Choose **Clients** → **Convert to Points**.

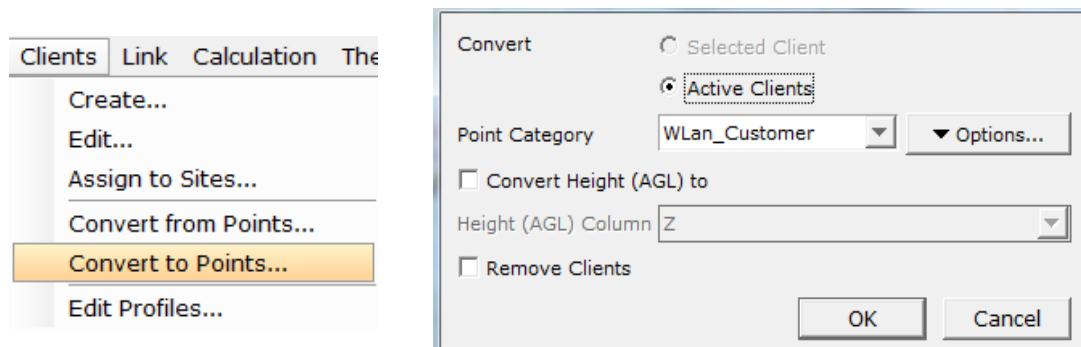


Figure 294: Convert clients to points

2. At first it needs to be decided whether a selected client or all active clients should be converted. To use the first option, a client needs to be selected in the **Project-Explorer** in the **Clients Tab** before *choosing **Clients→Convert to Points***.

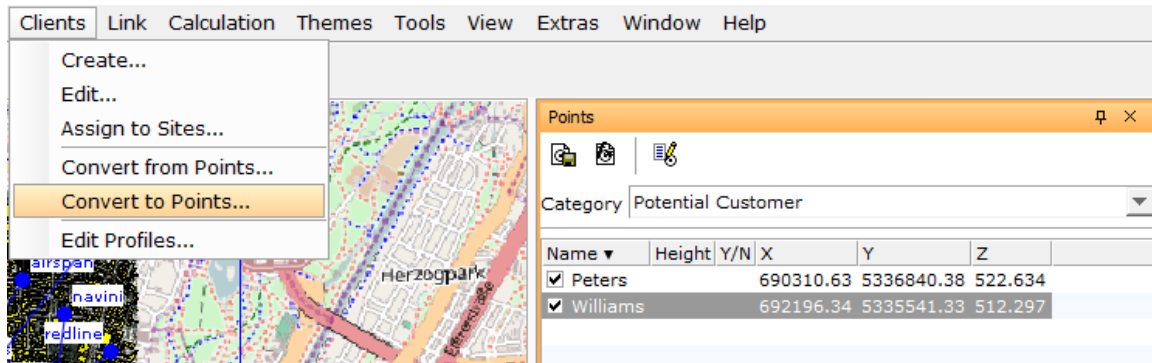


Figure 295: Mark a client and choose Convert to Points

Choose the point category that should be created from the clients and choose the **Height Column** of this point category. You can still uncheck the **Convert Height** checkbox. Feel free to create or edit new point categories by clicking on **Options→New** or **Options→Point Categories**.

Before finishing the conversion, choose the clients to be deleted after creating the points or still to occur afterwards.

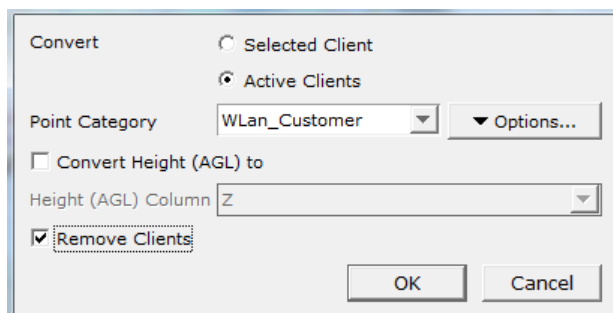


Figure 296: Remove clients after the conversion

3. Click **OK** to convert the clients to points.

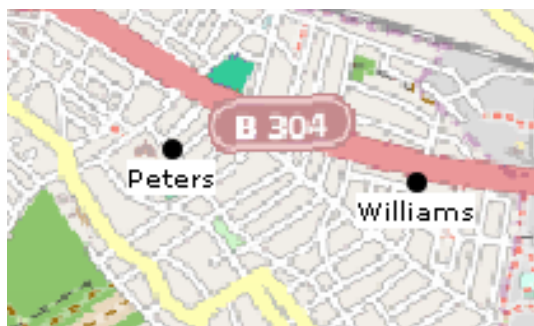


Figure 297: The points appear on the map

8.8 Point Parameters



8.8.1 How to Assign carrier

1. Take a right click on the point on the map or in the list tab of the points tab and click on **Edit....**

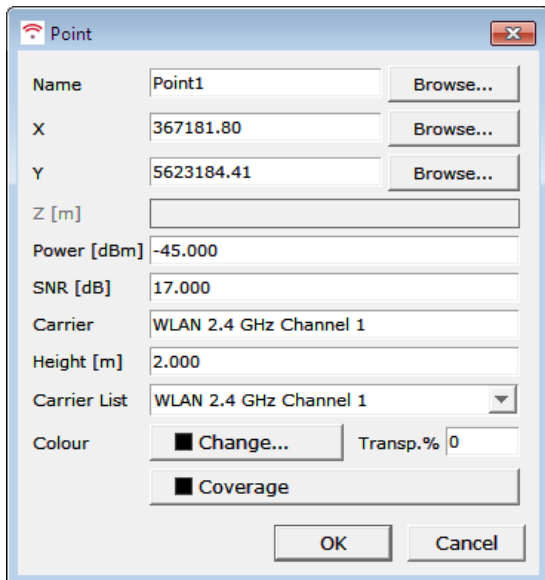


Figure 298: The edit window of a point

2. **Carrier List** selects the carrier of a list, a change will be applied in the text box **Carrier**. The text box can be changed manually but if the **Carrier** and the selected carrier by **Carrier List** are different, the function coverage cannot be used.

9 Clients

Clients can be set to a specific point to make some additional calculations to see if this exact point is covered with a specific power level and which station should be used to get a good signal. It can also be used for customer presentations. Clients can be arranged in different client profiles or newly created. This makes sure, that, for example, the user does not plan a project for customers which uses the 5 GHz technology with a 2.4 GHz technology. It is more attracting for a customer to see everything work out fine with using the specific real values.

9.1 Client Profiles

As mentioned before, the client profiles help the user to categorize customers in special groups that maybe only use a special technology like WiMAX or 5 GHz WLAN.



9.1.1 How to Create Client Profiles

1. Choose **Clients** → **Edit Profiles**.

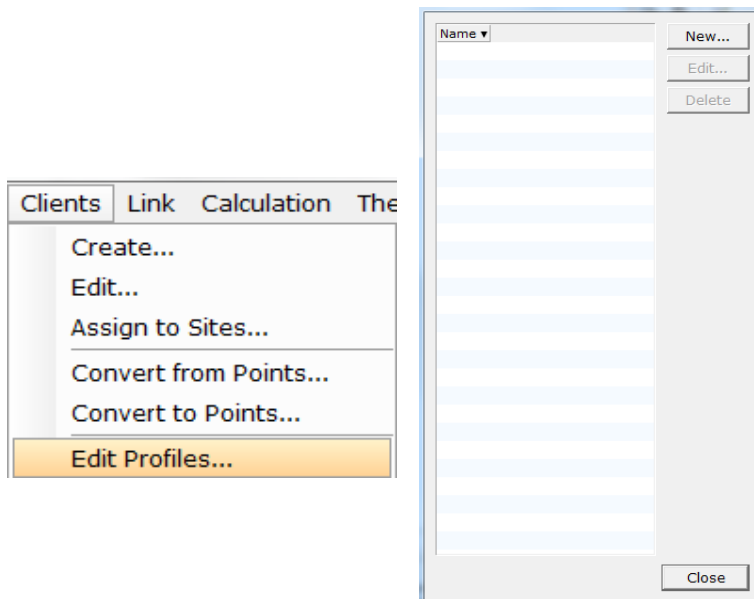


Figure 299: Create new client profiles

2. Choose **New** to create a new client profile.

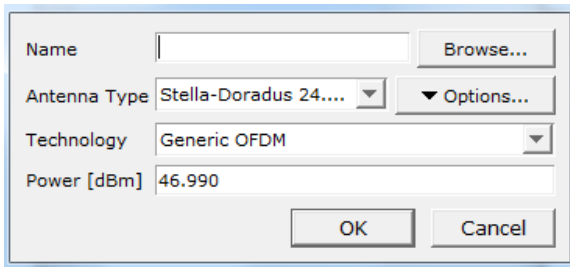


Figure 300: Fill in all fields

3. Name the new profile and choose the specific antenna type, technology and the power of the site.

If there are no antennas available, they have to be created before creating a client profile.



A short introduction how to create antennas can be found in chapter 7.1.1.2

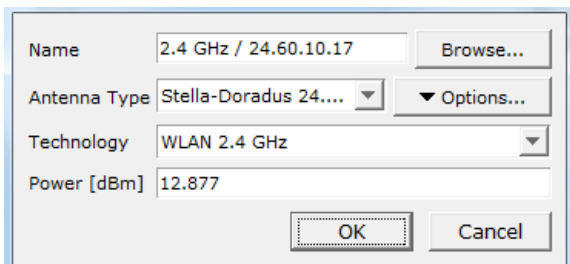


Figure 301: Fill in all fields

4. Click **OK** to add this profile to the project.

Generally the user needs to generate more than one profile, so create as many as you need.

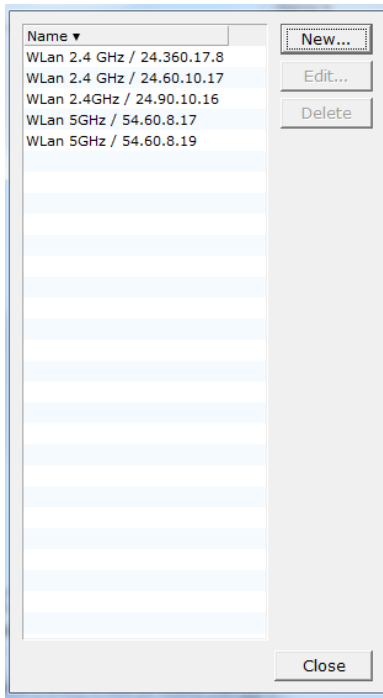


Figure 302: Created carriers

5. Click on **Close** to return to the map.



9.1.2 How to Edit Client Profiles

1. Choose **Clients** → **Edit Profiles**.

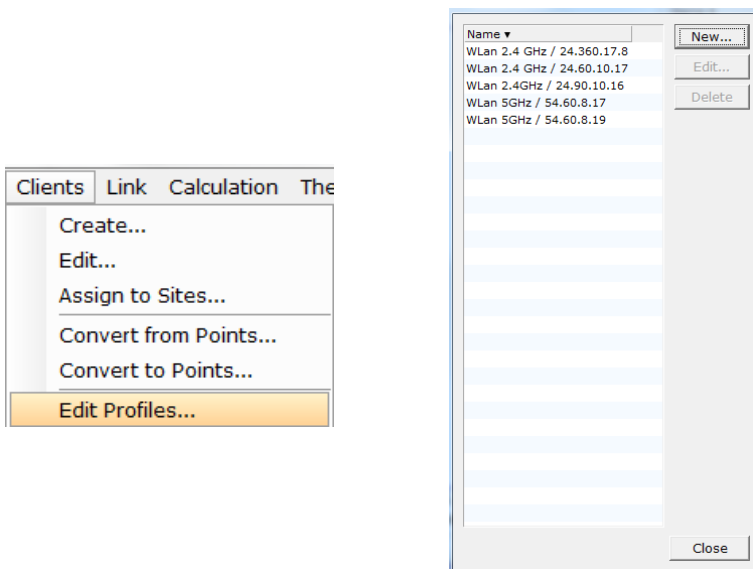


Figure 303: Edit carriers

2. Select a profile and click **OK** to edit it. If all settings are done, click **OK** to save the changes.

9.2 Client Creation

Assuming that all necessary client profiles have been added, a client can be created now.



9.2.1 How to Create Clients

1. There are three possibilities to create a client in WiMAP-4G:

- Choose **Clients**→**Create**.

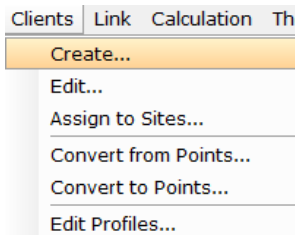


Figure 304: Create clients from the menu

- Right-click the desired position on the map and click on **Create Client**.

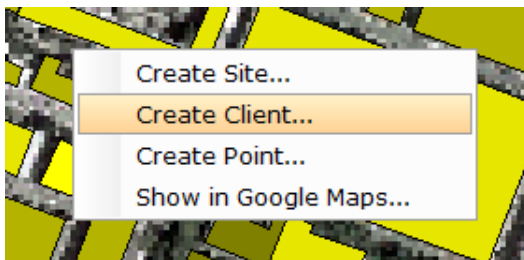


Figure 305: Create clients on the map

- Right-click in the **Clients Tab** and choose **New**.

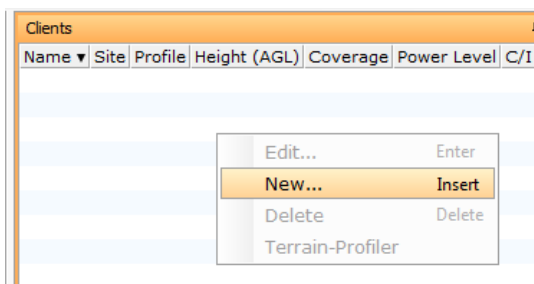


Figure 306: Create clients from the clients tab



Clients can also be created in the Project-Explorer by clicking "Insert".

2. In the appearing windows, *enter the following values*:

- **Name of the client** (usually the customer)
- **The site which should be used by the client.**
- **The Client profile** - A client profile needs to be chosen. In case there is none, it needs to be created here.



A short introduction how to create client profiles can be found in chapter 9.1.1.

- **The carrier that should be used by the client.** - The carrier needs to be chosen to continue. It needs to be created if none is existing.

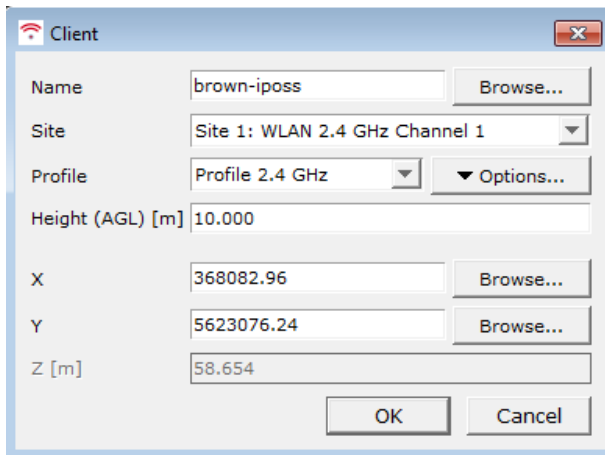


A short introduction how to create carrier profiles can be found in chapter 6.1.

- **The Height of the Clients Antenna** - This value is really important according to the site position.
- **X- and Y-coordinates of the Client** - If the client was created with a right click on the map, the coordinates should be precise, but it is the same as for the height. Minimal changes can be important to get a signal, so try to use exact coordinates.

Beside the rows, there is a **Browse Button** which allows to enter the coordinates. If the user knows client coordinates of a coordinate system which is not used for the actual project, he can use them anyway. The program itself will translate them to the actual project coordinate system.

- **The Z-coordinate** is the height of the ground itself. If an elevation model exists, the Z-coordinate will be set automatically to a value.



Client

Name: brown-iposs [Browse...]

Site: Site 1: WLAN 2.4 GHz Channel 1 [v]

Profile: Profile 2.4 GHz [v] [Options...]

Height (AGL) [m]: 10.000

X: 368082.96 [Browse...]

Y: 5623076.24 [Browse...]

Z [m]: 58.654

[OK] [Cancel]

Figure 307: Fill in all fields

3. If everything is set, *click on **OK** to create the client.*

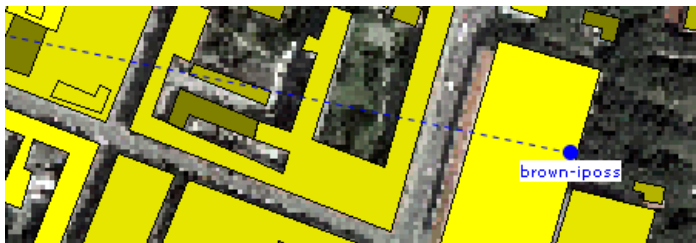


Figure 308: The client appears on the map

The client will show up on the map and a solid line connects him with the site that he has been assigned to.

9.3 Edit Clients

Sometimes it is necessary to edit clients, for instance, a customer has changed his position on the map or he uses a different technology now.



9.3.1 How to Edit Clients

1. There are three possibilities to edit clients:
 - *Right-click on the client on the map and click on **Edit**.*

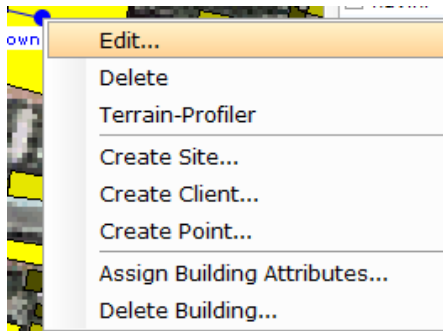


Figure 309: Edit clients from the menu

- Choose the **Client Tab** in the **Project-Explorer**, right-click on the client and choose **Edit**.

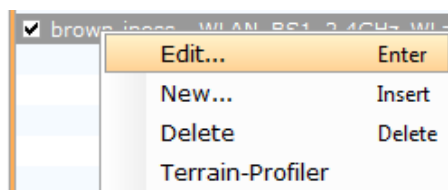


Figure 310: Edit clients in the clients tab

- Choose **Clients→Edit**.
(This is the fastest way to edit clients, because all clients are listed in the appearing window. The desired one can be chosen and edited by double clicking on it.)

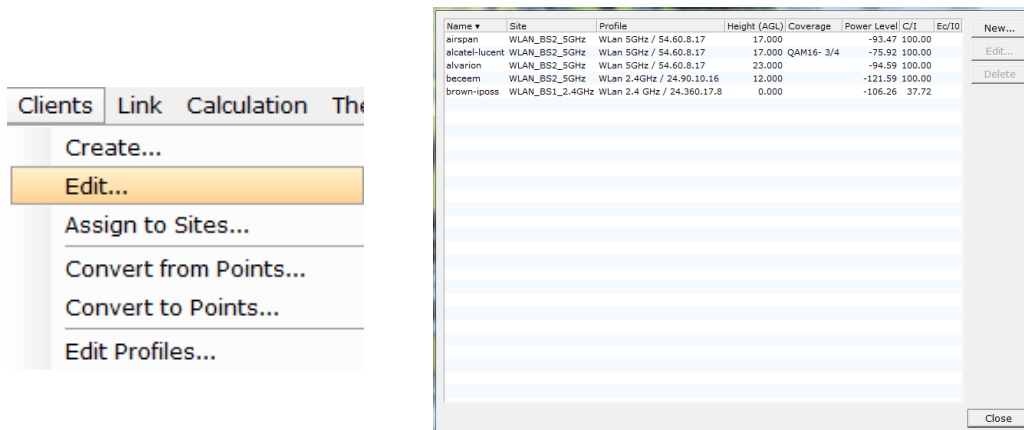


Figure 311: Choose the client and click on Edit.

- Change the values for the client and click on **OK** to save the settings.

9.4 Assign Clients to Sites

Clients can be assigned to the nearest site. To make it easier for the user, there is a setting to do that.



9.4.1 How to Assign Clients to Sites

1. Choose **Clients** → **Assign to Sites** and click on **OK**.

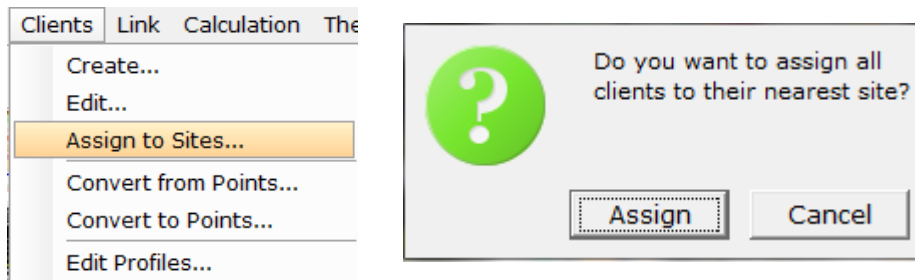


Figure 312: Assign clients to the nearest site

9.5 How to Use the Terrain-Profiler for Client to Site

1. Create a *client* like in 9.2.1 described.
2. Take a right click on a *client* and select **Terrain-Profiler** in the context menu.

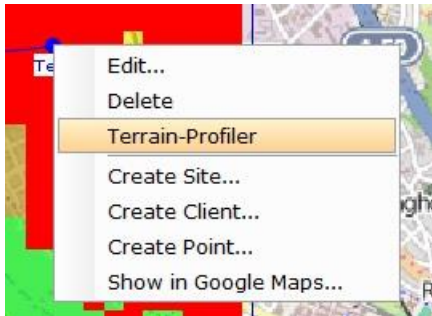


Figure 313: Context menu of a client

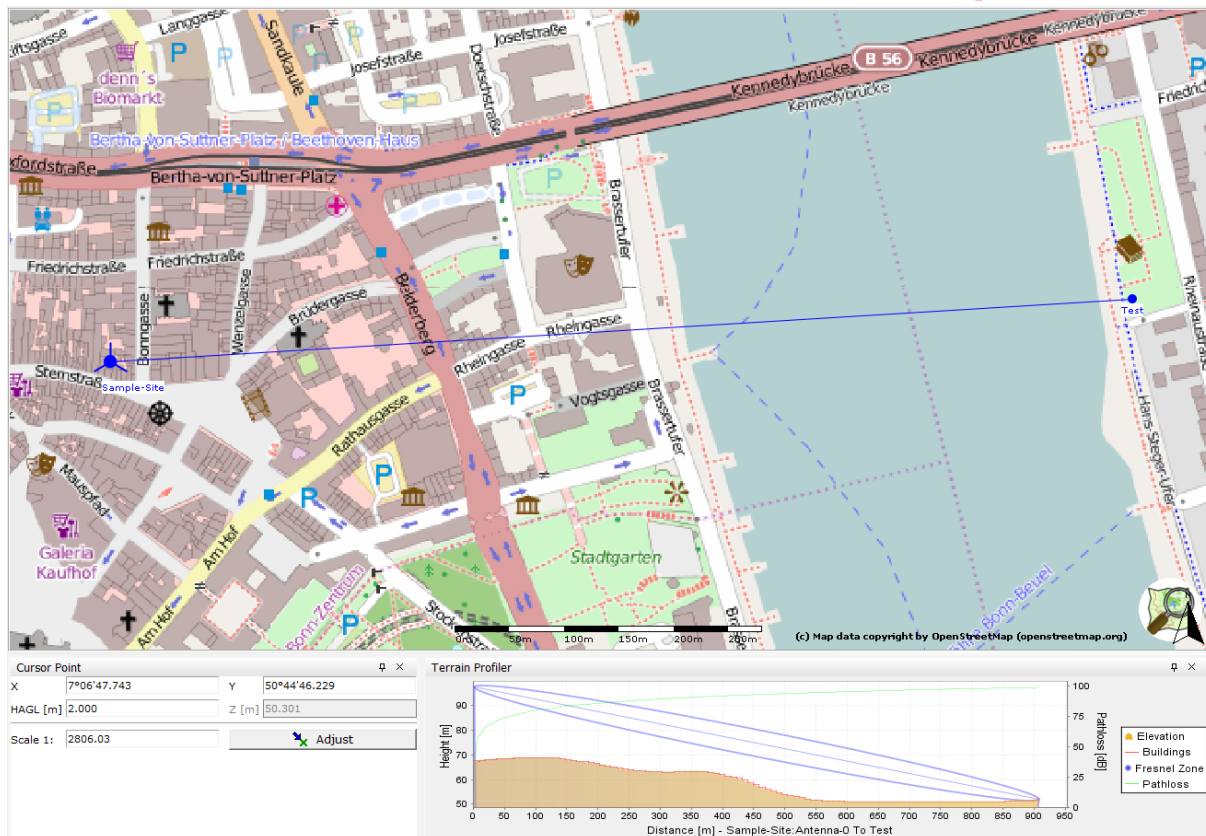


Figure 314: Terrain-Profile between client and site

9.6 Invalid Clients

An invalid client is marked in the client tab with red colour and a dashed line between the client and a site. A client is invalid if the carriers of the radio units of a site do not match with the carrier of the client.

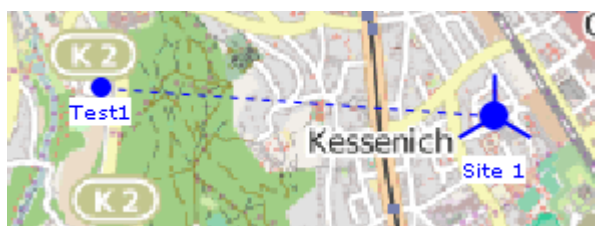


Figure 315: Invalid client on the map

Clients									
ID	Site	Carrier	Profile	Height (AGL)	Coverage	Power Level	Antenna Gain	Tx Power	C
Test1	Site 1	Test		0.000				8.00	

Figure 316: Invalid client in the clients tab

10 Calculations and Themes

Calculations and **themes** are the most interesting part of WiMAP-4G. Basically this is the aspect WiMAP-4G is in use. There are many detailed calculations and themes with a lot of settings that help to refine the result to the desired level. Before making any useful calculations or themes, the following things should be done:

- *elevation model imported*
- *correct sites created*
- *correct antennas created and used*
- *correct coordinates for antennas and sites*

Considering those as done, a proper calculation or theme can be made and the results can be used without any doubt. If there is no elevation model imported, the calculations or themes will be imprecise. These results should never be used to make a decision whether to build a planned scenario in reality or not.

10.1 Calculations and Theme Types

The following calculations are possible with WiMAP-4G:

- **field strength area**
- **client coverage**
- **point field strength**
- **site to site**

The follow themes are possible with WiMAP-4G:

- **coverage**
- **best server**
- **carrier to interferer**
- **power level**
- **sub carrier interference**
- **field strength**
- **elevation**
- **visibility**

Themes always need results from a basic calculation to start calculating itself. So if an error occurs or nothing is shown after creating a theme, the first thing to check is whether the corresponding basic calculations have been done or not.

10.2 The Field Strength Area Calculation

The **field strength area calculation** is the most used calculation and always the basic calculation that has to be done before creating a theme. It shows the field strength for the whole marked blue area or if zoomed in, for the whole screen. The field strength area calculation can be made with all propagation models, except CORLA, where a license is needed for.



A license file is needed to use CORLA. This license is limited to a project and can be ordered at WIMAP-4G product support (info@brown-iposs.eu).



10.2.1 How to Make a Field Strength Area Calculation

1. There are three possibilities to open the field strength area calculation window:

- Choose **Calculation** → **Area Field Strength**.

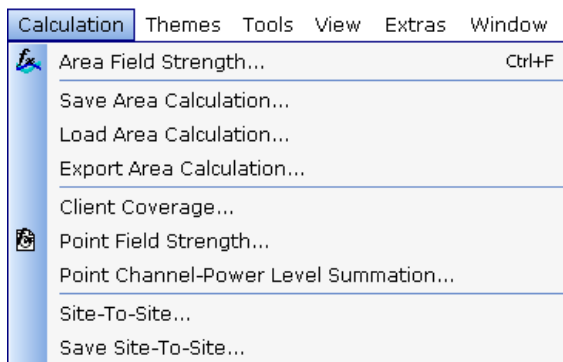


Figure 317: Make a field strength area calculation

- Click on  in the **control bar**.

- The shortcut for the field strength area calculation is **CTRL+F**.

2. The field strength area calculation window opens and some settings according to the situation have to be done.

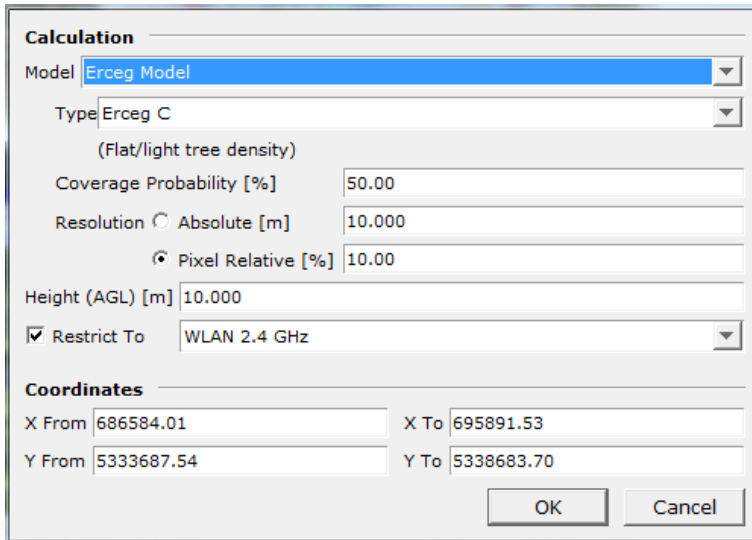


Figure 318: Field strength area calculation settings for the Erceg model

At first it has to be decided which propagation model should be used. All remaining settings depend on the specific propagation model.

10.2.1.1 With the Erceg Model

The first thing to decide is whether the calculation should be made with the Erceg A, B or C model. It depends on the environmental circumstances.

A: Hilly terrain with moderate to heavy tree density. This model is associated with the highest path loss.

B: Terrain type B is characterized by mostly flat terrain with moderate to heavy tree densities or a hilly terrain with light tree densities.

C: Terrain type C is used for flat terrain with light tree densities, producing the lowest path loss.

Custom: It is also possible to create a custom profile in the WiMAP-4G settings. This is only recommended for experienced users, who know the used parameters exactly and can handle them correctly.



For Community-Edition users, the calculation cannot be more precise than 50 m, which is usually enough to get an overview but not enough for a precise calculation.

Calculation

Model Erceg Model

Type Erceg A

(Hilly/moderate-to-heavy tree density)

Coverage Probability [%] 50.00

Resolution Absolute [m] 10.000

Pixel Relative [%] 10.00

Height (AGL) [m] 10.000

☒ Restrict To WLAN 2.4 GHz

Coordinates

X From 687177.39 X To 695298.15

Y From 5333875.62 Y To 5338495.62

OK

Cancel

Figure 319: Calculation with Erceg model Type A

The coverage probability has to be set. It can be set to a standard value in the WiMAP-4G-settings. The function of that value is a little bit tricky to understand. It describes the chance that - considering all circumstances - a specific point receives the calculated field strength in real terms. The coverage is always based on probability theory and cannot be guaranteed 100 % of the time. This probability may be affected by weather or atmospheric conditions. For high frequency carriers the weather can make the little difference between a working and a useless signal. The temperature is able to affect the coverage, too. Depending on this, it is always recommended to set this value not too low. The calculation result may look very nice in theory, but in reality none of the customers may receive a satisfying signal. A good result with a high value as for example 70 % is a good basis for a real project.

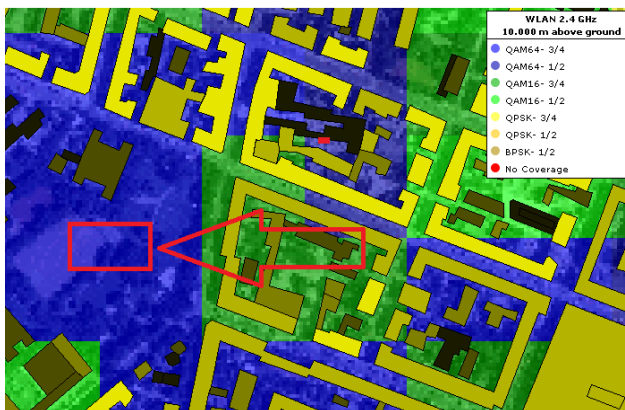


Figure 320: 50 % coverage probability

For example the rectangle in Figure 320 has a 50 % chance receiving a signal, which can be demodulated with QAM 64.



To change the model parameters or the standard coverage probability, see chapter 3.1.2.2.3

The resolution of the calculation can be set to % or meter. Higher % means higher precision whereas the value in m needs to be low for higher precision. Note that a higher precision always requires more time for calculation.

It can take hours or even days if the project is large. So keep in mind to run a test calculation with a low precision first. Nothing is more frustrating than to calculate a project for a few hours when the result looks bad because something has been overlooked.

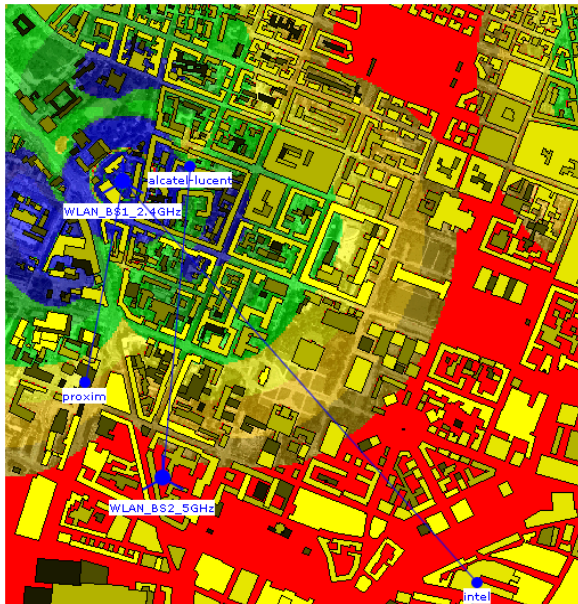


Figure 321: A field strength area calculation example: Munich, Erceg A, coverage probability: 50 %, resolution: absolute 5 m

10.2.1.2 With the CORLA Raylauncher Model

The CORLA Raylauncher settings which can be made during a field strength area calculation are limited. First of all, the precision in X/Y-direction and in Z-direction can be set in meter. Note that a higher precision always requires more time for calculation. This can take hours or even days if the project is large. So keep in mind to run a test calculation with a low precision first. Nothing is more frustrating than to calculate a project for a few hours when the result looks bad because something has been overlooked.

Choose a **working directory** for CORLA. Usually it does not need to be edited. CORLA only needs to create a few temporary files while calculating.

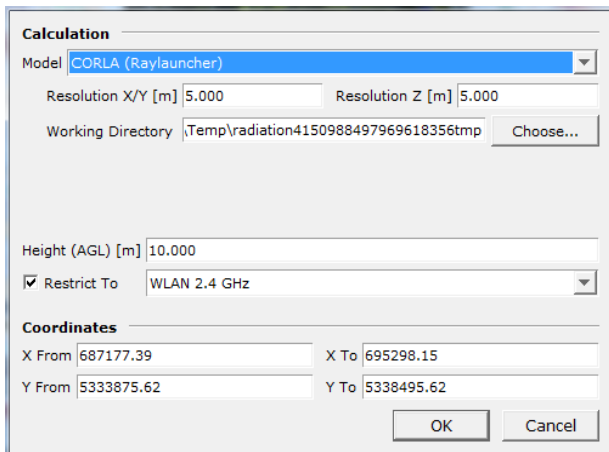


Figure 322: Field strength area calculation settings for CORLA Raylauncher



To configure the CORLA Raylauncher, see chapter 3.1.2.3.



Note that the CORLA Raylauncher needs a license for a specific environment and can only be used by Professional-Edition users.

10.2.1.3 With the ITU-R P.1411-3 Model

Choose the **average road orientation** in °. This can be set to a standard value in the settings.

The resolution of the calculation can be set to % or meter. Higher % means higher precision whereas the value in m needs to be low for higher precision. Note, that a higher precision always requires more time for calculation. This can take hours or even days if the project is large. So keep in mind to run a test calculation with a low precision first. Nothing is more frustrating than to calculate a project for a few hours when the result looks bad because something has been overlooked.

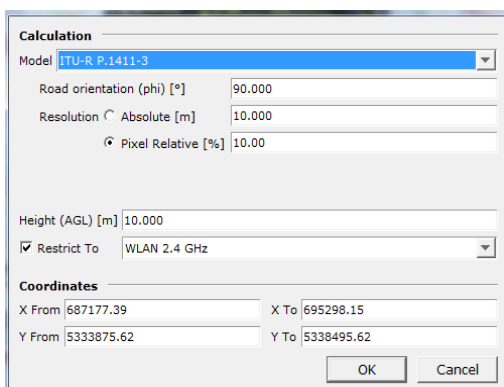


Figure 323: Field strength area calculation settings for ITU-R P.1411-3



To configure the ITU-R P.1411-3, see chapter 3.1.2.2.2.

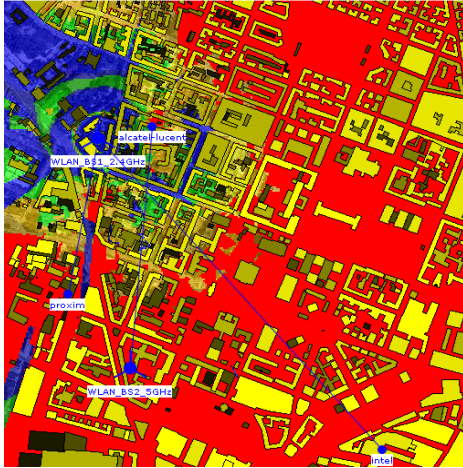


Figure 324: A field strength area calculation example: Munich, ITU-R P.1411-3, road orientation: 90°, resolution: absolute 5 m

10.2.1.4 With the Free Space Propagation Model

The Free Space Propagation Model is the easiest model of all and therefore it does not need a lot of adjustments. The resolution of the calculation can be set either in % or in meter. Higher % means higher precision whereas the value in m needs to be low for a good precision. Note, that a higher precision always requires more time for calculation. This can take hours or even days if the project is large. So keep in mind to run a test calculation with a low precision first. Nothing is more frustrating than to calculate a project for a few hours when the result looks bad because something has been overlooked.

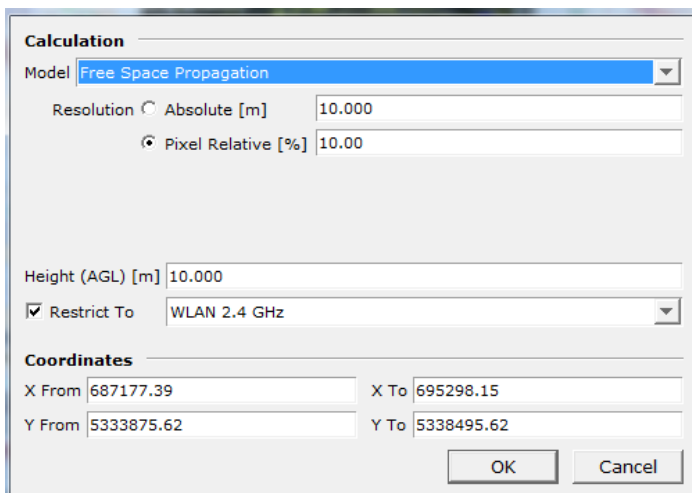


Figure 325: Field strength area calculation settings for Free Space Propagation



To configure the Free Space Propagation Model, see chapter 3.1.2.2.1.

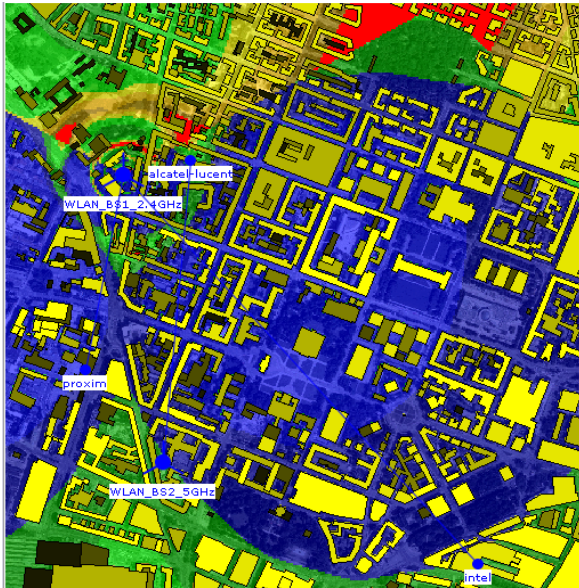


Figure 326: A field strength area calculation example: Munich, Free Space Propagation, Resolution: absolute 5 m

10.2.1.5 With WinProp

WinProp is for propagation modeling in different scenarios with different model types of calculation.

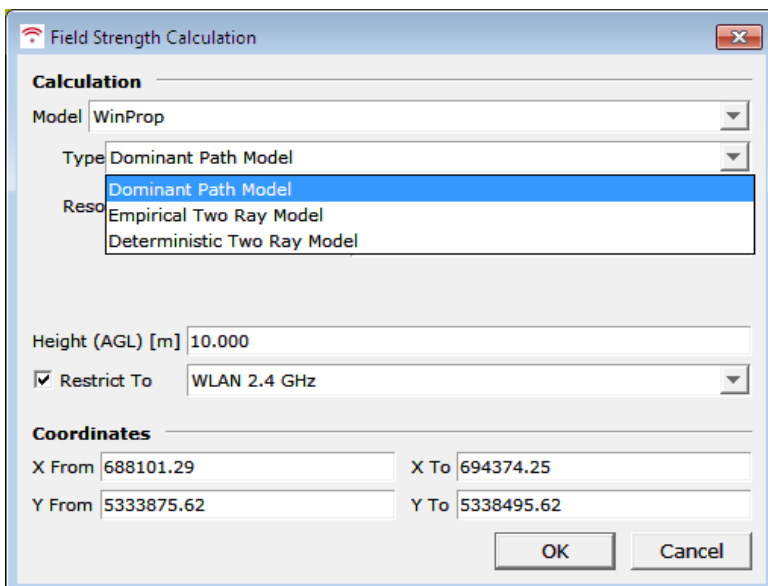


Figure 327: WinProp field strength calculations settings

The **Dominant Path Model** calculates the path loss on the main paths between transmitter and each receiver pixel by high precision like the ray tracing.

The **Empirical Two Ray Model** calculates the path loss by each pixel on the map without looking if the point is hidden or unreachable.

The **Deterministic Two Ray Model** calculates the path loss by each pixel on the map with checking whether the point is not hidden and reachable.



A special license is needed to use WinProp models, which can be ordered at WIMAP-4G product support (info@brown-iposs.eu).

10.2.1.6 General Settings

After deciding on a propagation model and configuring it, there are a few additional settings that need to be done. First of all, we need to set the height of the calculation above ground level. Usually this value should be something as the antenna height or corresponding. A low value, 1 m for example, could cause a bad result because at this height there are a lot of interferers for the signal.

Next thing to decide is if the calculation is restricted to a specific technology. This can be useful in large projects with many different technologies in use. Note that the program will simply calculate in all technologies without a restriction which may double or multiply the calculation time in some cases.

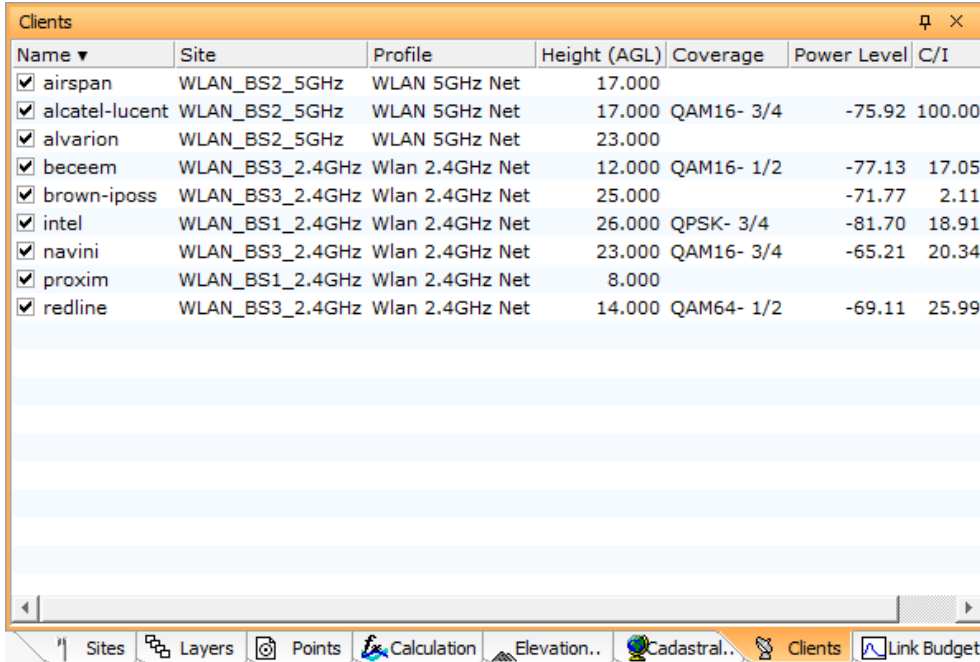
At last, the specific coordinates of the calculated area can be set. If the blue area frame is shown on the screen, the coordinates will always be the coordinates of the vertices of that blue frame.

When all settings are done, *click on **OK** to start the calculation*. As mentioned above, a calculation can take some time, so do not close the program.

10.3 The Client Coverage Calculation

The **client coverage calculation** is a useful feature of WiMAP-4G, for example, to calculate the exact power level for the real position of a client. The alternative to get a power level for a client is simply to read them on the map after doing a power level calculation. This alternative will not be exact as long as the user does not specify a few 1000 colour profiles. It is not necessary because of the client coverage calculation.

The client tab in the Project-Explorer shows all clients used in the current project and the according values: coverage, power level, C/I (carrier to interferer).



Name ▼	Site	Profile	Height (AGL)	Coverage	Power Level	C/I
☒ airspan	WLAN_BS2_5GHz	WLAN 5GHz Net	17.000			
☒ alcatel-lucent	WLAN_BS2_5GHz	WLAN 5GHz Net	17.000	QAM16- 3/4	-75.92	100.00
☒ alvarion	WLAN_BS2_5GHz	WLAN 5GHz Net	23.000			
☒ beceem	WLAN_BS3_2.4GHz	Wlan 2.4GHz Net	12.000	QAM16- 1/2	-77.13	17.05
☒ brown-iposs	WLAN_BS3_2.4GHz	Wlan 2.4GHz Net	25.000		-71.77	2.11
☒ intel	WLAN_BS1_2.4GHz	Wlan 2.4GHz Net	26.000	QPSK- 3/4	-81.70	18.91
☒ navini	WLAN_BS3_2.4GHz	Wlan 2.4GHz Net	23.000	QAM16- 3/4	-65.21	20.34
☒ proxim	WLAN_BS1_2.4GHz	Wlan 2.4GHz Net	8.000			
☒ redline	WLAN_BS3_2.4GHz	Wlan 2.4GHz Net	14.000	QAM64- 1/2	-69.11	25.99

Figure 328: The clients tab in the Project-Explorer

Note that the client coverage calculation does not show any visual effects in the Terrain-Explorer. Only the clients tab in the Project-Explorer will change during a calculation.



If not all columns are visible, the Project-Explorer needs to be dragged to the right width.



10.3.1 How to Make a Client Coverage Calculation

1. Choose **Calculation** → **Client Coverage**.

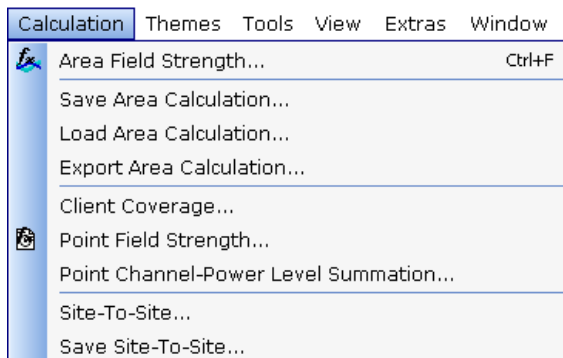


Figure 329: Open the client coverage calculation settings

2. The client coverage calculation window opens and some settings according to the situation have to be done.

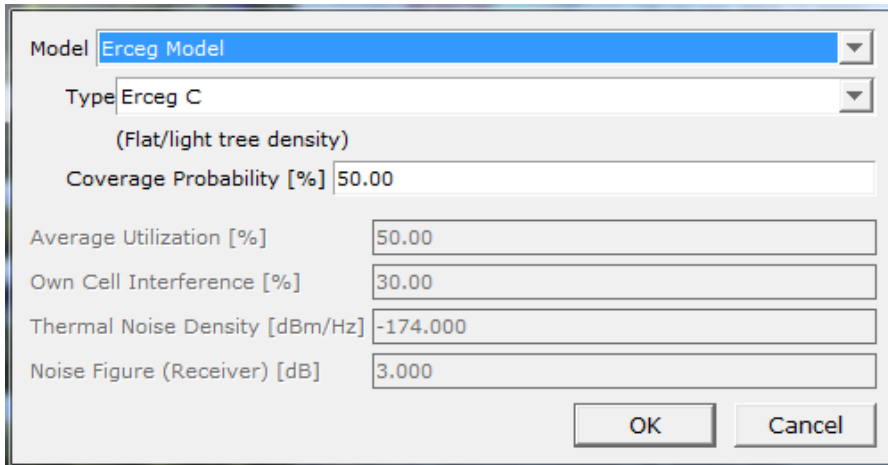


Figure 330: The coverage calculation settings

First of all, a propagation model needs to be chosen. The rest of the settings depends on the specific propagation model.

10.3.1.1 With the Erceg Model

The first thing to decide is whether the calculation should be made with the Erceg A, B or C model. It depends on the environmental circumstances.

A: Hilly terrain with moderate to heavy tree density. This model is associated with the highest path loss.

B: Terrain type B is characterized by mostly flat terrain with moderate to heavy tree densities or a hilly terrain with light tree densities.

C: Terrain type C is used for flat terrain with light tree densities, producing the lowest path loss.

Custom: It is also possible to create a custom profile in the WiMAP-4G settings. This is only recommended for experienced users, who know the exact used parameters and can handle them correctly.

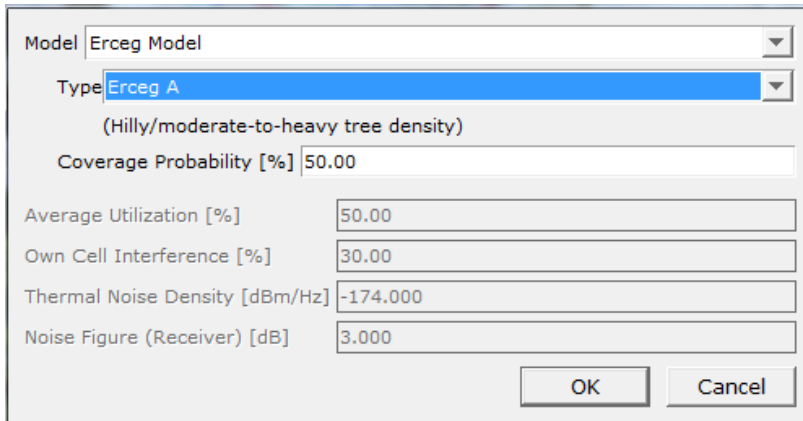


Figure 331: Calculation with Erceg model type A

The coverage probability has to be set. It can also be set to a standard value in the WiMAP-4G-settings. The function of that value is a little bit tricky to understand. It describes the chance that - considering all circumstances - a specific point receives the calculated field strength in real terms. The coverage is always based on probability theory and cannot be guaranteed 100 % of the time. This probability maybe affected by weather or atmospheric conditions.

For high frequency carriers the weather can make the little difference between a working and a useless signal. The temperature is able to affect the coverage, too. Depending on this, it is always recommended to set this value not too low. The calculation result may look very nice in theory, but in reality none of the customers may receive a satisfying signal. A good result with a high value as for example 70 % is a good basis for a real project.

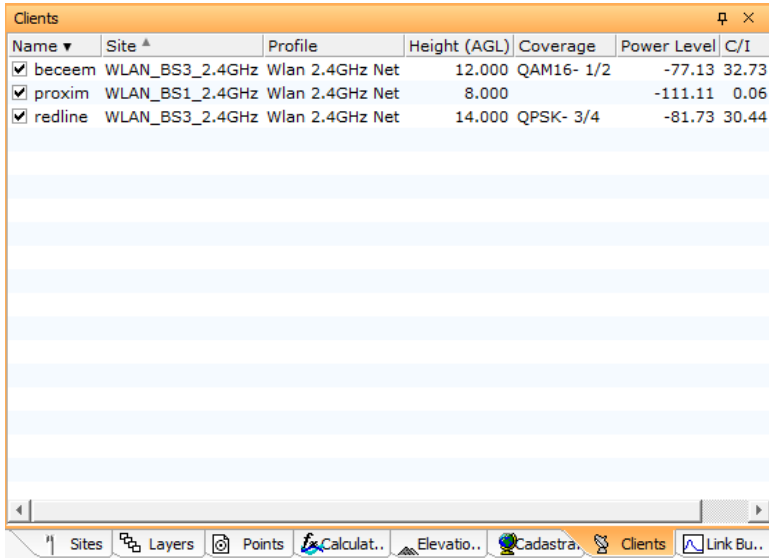


Figure 332: 50 % coverage probability

For example the rectangle in Figure 332 has a 50 % chance for this area receiving a signal, which can be demodulated with QAM 64.



To change the model parameters or the standard coverage probability, see chapter 3.1.2.2.3.

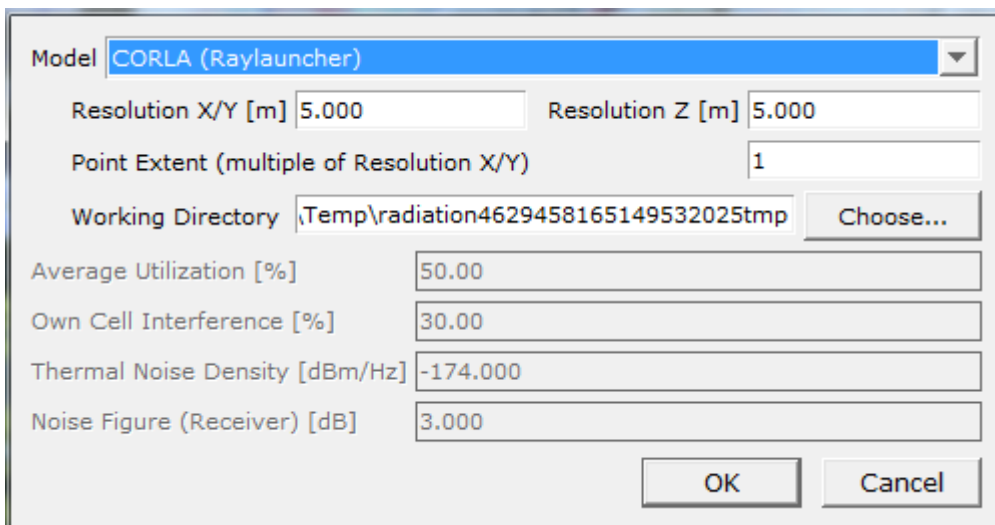


Name	Site	Profile	Height (AGL)	Coverage	Power Level	C/I
✓ beceem	WLAN_BS3_2.4GHz	Wlan 2.4GHz Net	12.000	QAM16- 1/2	-77.13	32.73
✓ proxim	WLAN_BS1_2.4GHz	Wlan 2.4GHz Net	8.000		-111.11	0.06
✓ redline	WLAN_BS3_2.4GHz	Wlan 2.4GHz Net	14.000	QPSK- 3/4	-81.73	30.44

Figure 333: A client coverage calculation example: Munich, Erceg A, coverage probability: 50 %

10.3.1.2 With the CORLA Raylauncher Model

The CORLA Raylauncher settings which can be made during a client coverage calculation are limited. First of all, the precision in X-/Y-direction and in Z-direction can be set in meter. Note that a higher precision always requires more time for calculation. This can take hours or even days if the project is large. So keep in mind to run a test calculation with a low precision first. Nothing is more frustrating than to calculate a project for a few hours when the result looks bad because something has been overlooked.



Model: CORLA (Raylauncher)

Resolution X/Y [m]: 5.000 Resolution Z [m]: 5.000

Point Extent (multiple of Resolution X/Y): 1

Working Directory: Temp\radiation4629458165149532025tmp Choose...

Average Utilization [%]: 50.00

Own Cell Interference [%]: 30.00

Thermal Noise Density [dBm/Hz]: -174.000

Noise Figure (Receiver) [dB]: 3.000

OK Cancel

Figure 334: Client coverage calculation settings for CORLA

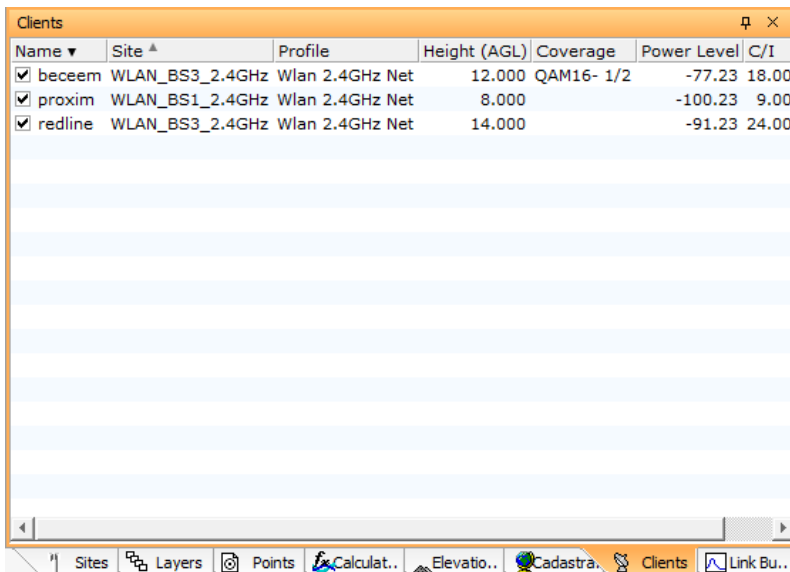
Choose a **working directory** for CORLA. Usually it does not need to be edited. CORLA only needs to create a few temporary files while calculating.



To configure the CORLA Raylauncher, see chapter 3.1.2.3.



Note that the CORLA Raylauncher needs a license for a specific environment and can only be used by Professional-Edition users.

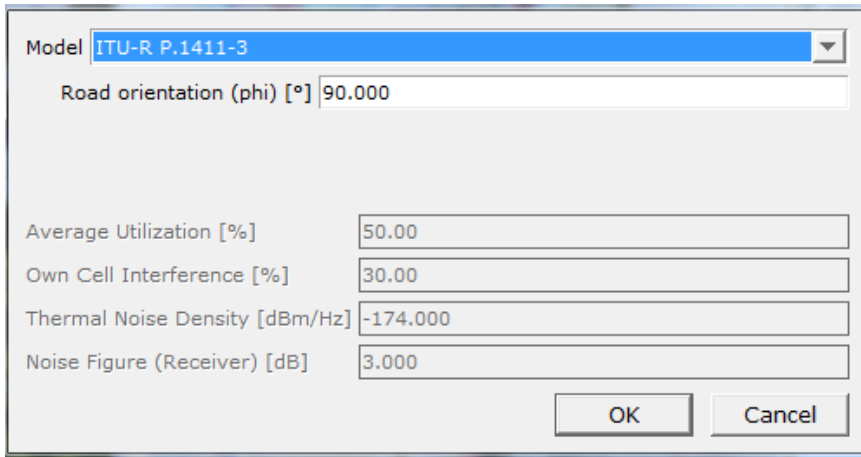


Name ▼	Site ▲	Profile	Height (AGL)	Coverage	Power Level	C/I
☒ beceem	WLAN_BS3_2.4GHz	Wlan 2.4GHz Net	12.000	QAM16- 1/2	-77.23	18.00
☒ proxim	WLAN_BS1_2.4GHz	Wlan 2.4GHz Net	8.000		-100.23	9.00
☒ redline	WLAN_BS3_2.4GHz	Wlan 2.4GHz Net	14.000		-91.23	24.00

Figure 335: A client coverage calculation example: Munich, CORLA, resolution x/y: 3, resolution z: 3, point extent: 1

10.3.1.3 With the ITU-R P.1411-3 Model

Choose the **average road orientation** in °. This can be set to a standard value in the settings.



Model: ITU-R P.1411-3

Road orientation (phi) [°]: 90.000

Average Utilization [%]: 50.00

Own Cell Interference [%]: 30.00

Thermal Noise Density [dBm/Hz]: -174.000

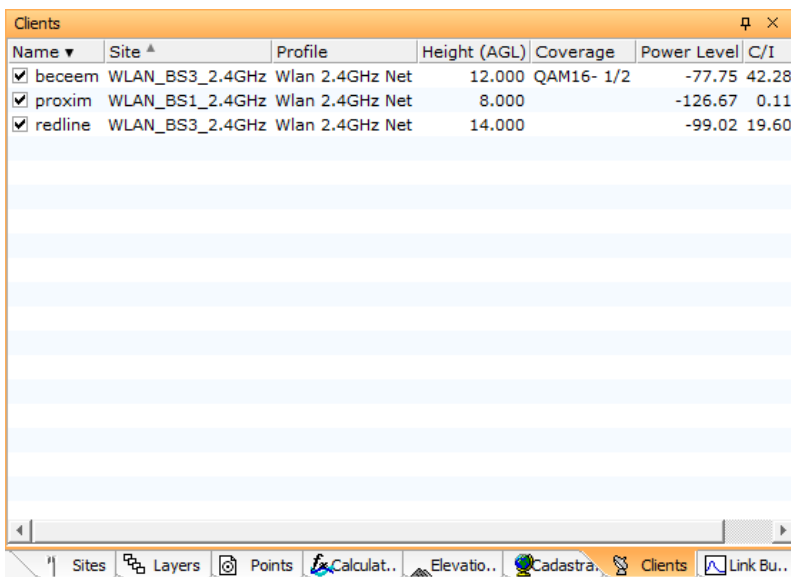
Noise Figure (Receiver) [dB]: 3.000

OK Cancel

Figure 336: Client coverage calculation settings for ITU-R P.1411-3



To configure the ITU-R P.1411-3, see Chapter 3.1.2.2.2.

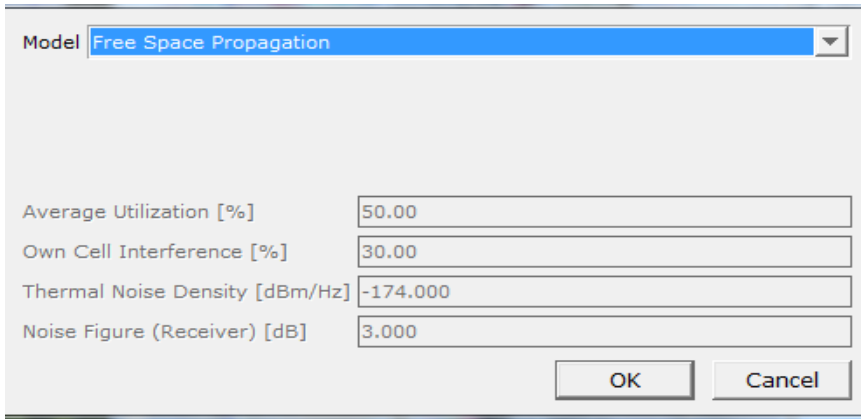


Name	Site	Profile	Height (AGL)	Coverage	Power Level	C/I
☒ beceem	WLAN_BS3_2.4GHz	Wlan 2.4GHz Net	12.000	QAM16- 1/2	-77.75	42.28
☒ proxim	WLAN_BS1_2.4GHz	Wlan 2.4GHz Net	8.000		-126.67	0.11
☒ redline	WLAN_BS3_2.4GHz	Wlan 2.4GHz Net	14.000		-99.02	19.60

Figure 337: A client coverage calculation example: Munich, ITU-R P.1411-3, road orientation: 90°

10.3.1.4 With the Free Space Propagation Model

The Free Space Propagation Model is the easiest model, it does not need any parameters.



Model: Free Space Propagation

Average Utilization [%]: 50.00

Own Cell Interference [%]: 30.00

Thermal Noise Density [dBm/Hz]: -174.000

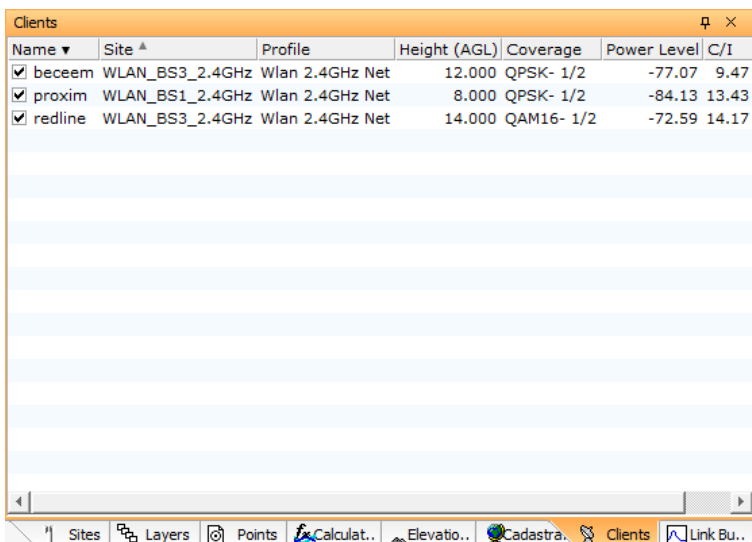
Noise Figure (Receiver) [dB]: 3.000

OK Cancel

Figure 338: Client coverage calculation settings for Free Space Propagation



To configure the Free Space Propagation model, see chapter 3.1.2.2.1.

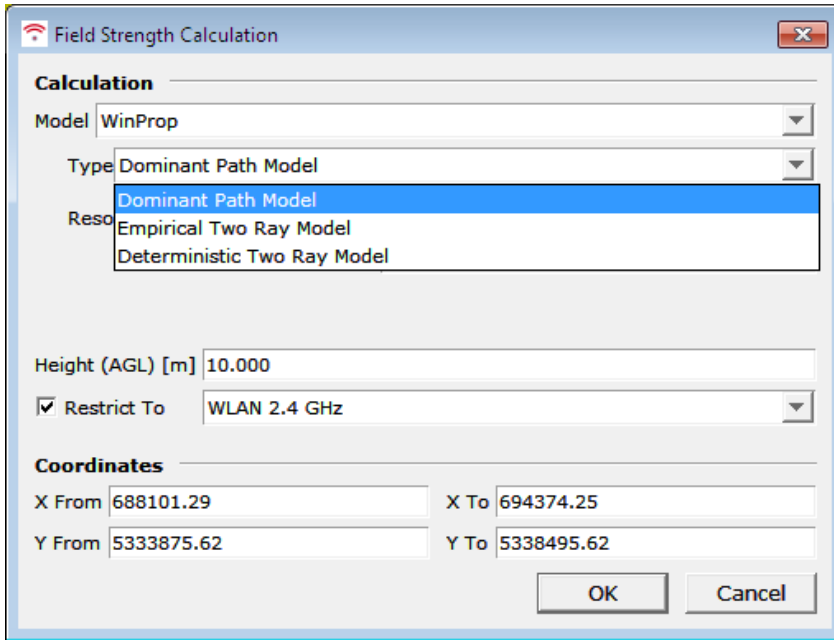


Name	Site	Profile	Height (AGL)	Coverage	Power Level	C/I
☒ beceem	WLAN_BS3_2.4GHz	Wlan 2.4GHz Net	12.000	QPSK- 1/2	-77.07	9.47
☒ proxim	WLAN_BS1_2.4GHz	Wlan 2.4GHz Net	8.000	QPSK- 1/2	-84.13	13.43
☒ redline	WLAN_BS3_2.4GHz	Wlan 2.4GHz Net	14.000	QAM16- 1/2	-72.59	14.17

Figure 339: A client coverage calculation example: Munich, Free Space Propagation

10.3.1.5 With WinProp

WinProp is for propagation modeling in different scenarios.



Field Strength Calculation

Calculation

Model: WinProp

Type: Dominant Path Model

Resolution: Dominant Path Model, Empirical Two Ray Model, Deterministic Two Ray Model

Height (AGL) [m]: 10.000

☒ Restrict To: WLAN 2.4 GHz

Coordinates

X From: 688101.29 X To: 694374.25

Y From: 5333875.62 Y To: 5338495.62

OK Cancel

Figure 340: WinProp field strength calculations settings

The **Dominant Path Model** calculates the main paths between transmitter and each receiver pixel by high precision like the ray tracing.

The **Empirical Two Ray Model** calculates the path loss by each pixel on the map, without looking for the point is hidden or unreachable.

The **Deterministic Two Ray Model** calculates the path loss by each pixel on the map with checking whether the point is not hidden and reachable.



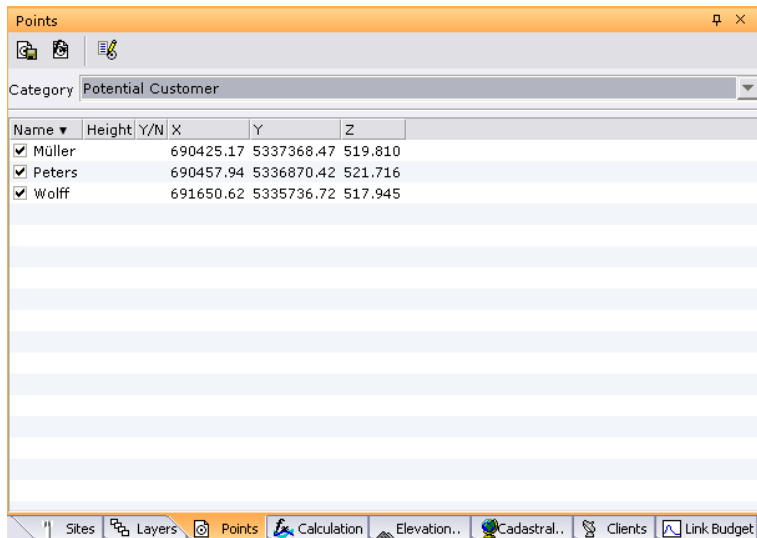
A special license is needed to use WinProp models. This license can be ordered at WIMAP-4G product support (info@brown-iposs.eu).

10.4 The Point Field Strength Calculation

The **point field strength calculation** works similar to the client coverage calculation and therefore it is a powerful tool. The exact field strength and power level for each point on the map can be calculated easily using this feature. The alternative to get a power level and field strength for points is to just read them on the map after creating a power level theme. This will not be exact as long as the user does not specify a few 1000 colour profiles. The field strength of a point can be calculated instead. The points tab in the Project-Explorer shows all points used in the current project.



To create points on the map see chapter 8.3.1



Name	Height	Y/N	X	Y	Z
☒ Müller	690425.17	5337368.47	519.810		
☒ Peters	690457.94	5336870.42	521.716		
☒ Wolff	691650.62	5335736.72	517.945		

Figure 341: The points tab in the Project-Explorer

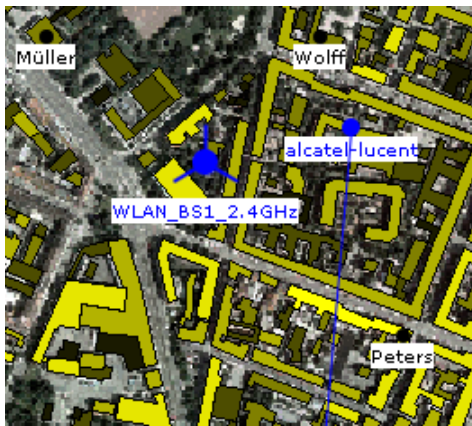


Figure 342: The points on the Terrain-Explorer

Figure 342 shows the points of the corresponding point category. A field strength or power level column is required for this calculation to make sense. They need to be created for the corresponding point category before making a point field strength calculation.



To edit point classes see chapter 9.1.1 and 9.1.2.

If the point categories have been edited correctly, the **Points tab** should look like in Figure 343:

broadband wireless networks - investigations • planning • operations support systems

Points

Category: Potential Customer

Name	Height	Y/N	Power Level	Field Strength	X	Y	Z
☒ Müller	10.000				690425.17	5337368.47	519.810
☒ Peters	8.000				690457.94	5336870.42	521.716
☒ Wolff	7.000				691650.62	5335736.72	517.945

Sites Layers Points Calculation Elevation.. Cadastral.. Clients Link Budget

Figure 343: The points tab in the Project-Explorer with additional power level and field strength columns

The height of a point also influences the calculation result and should be entered into the corresponding field.



10.4.1 How to Make a Point Field Strength Calculation

After editing the point categories and the correct information to the corresponding fields, a point field strength calculation can be done.

1. There are two possibilities to make a point field strength calculation:

- Choose **Calculation** → **Point Field Strength**.

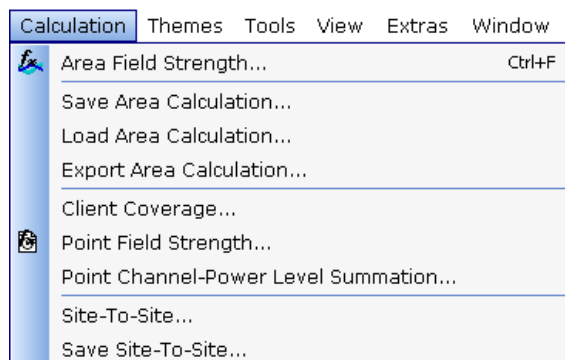
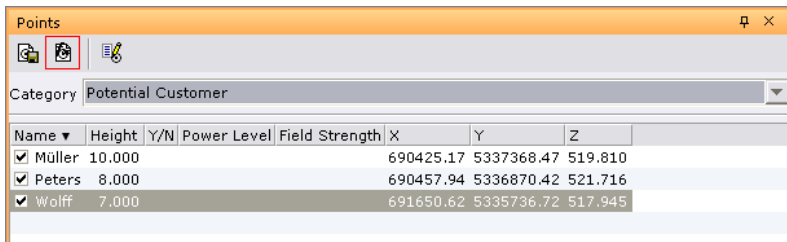


Figure 344: Open the settings from menu

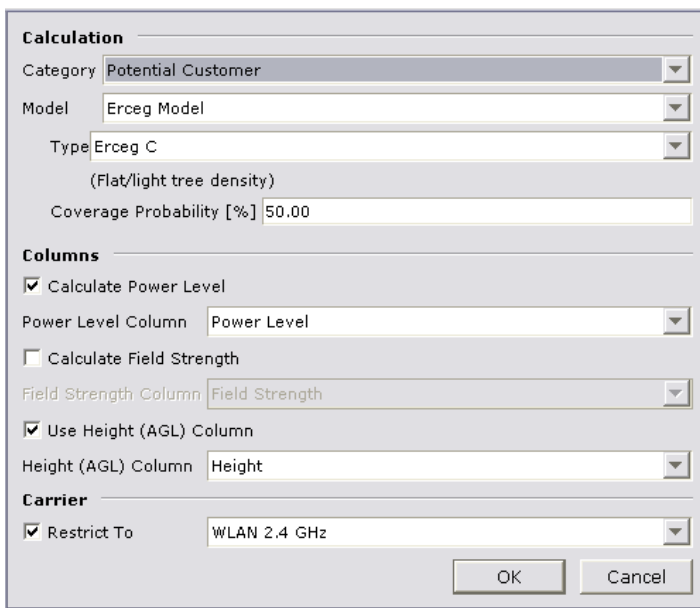
- Click on the  in the **point tab** in the **Project- Explorer**.



Name	Height	Y/N	Power Level	Field Strength	X	Y	Z
✓ Müller	10.000				690425.17	5337368.47	519.810
✓ Peters	8.000				690457.94	5336870.42	521.716
✓ Wolff	7.000				691650.62	5335736.72	517.945

Figure 345: Open the settings from points tab

- When the point field strength calculation window opens, some settings according to the situation have to be done.



Calculation

Category: Potential Customer

Model: Erceg Model

Type: Erceg C
(Flat/light tree density)

Coverage Probability [%]: 50.00

Columns

☒ Calculate Power Level
Power Level Column: Power Level

☐ Calculate Field Strength
Field Strength Column: Field Strength

☒ Use Height (AGL) Column
Height (AGL) Column: Height

Carrier

☒ Restrict To: WLAN 2.4 GHz

OK Cancel

Figure 346: The point field strength calculation settings

First of all, it needs to be decided which points should be calculated. All points corresponding to the same point category can be calculated at one time. In this tutorial, all points associated with the point category **Potential Customer** will be calculated.



10.4.1.1 With the Erceg Model

The first thing to decide is whether the calculation should be made with the Erceg A, B or C model. It depends on the environmental circumstances.

A: Hilly terrain with moderate to heavy tree density. This model is associated with the highest path loss.

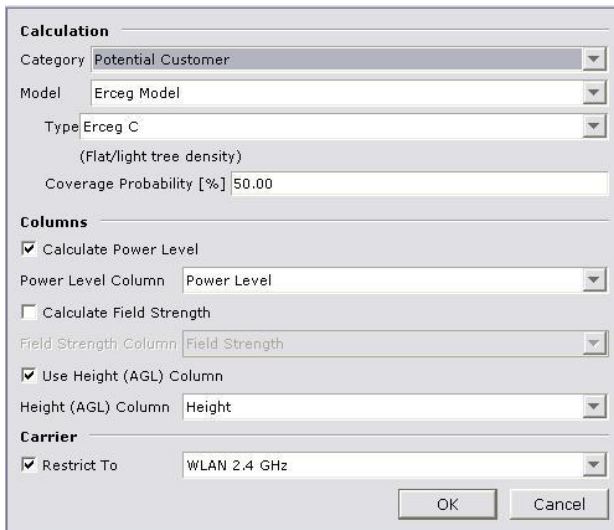
B: Terrain type B is characterized by mostly flat terrain with moderate to heavy tree densities or a hilly terrain with light tree densities.

C: Terrain type C is used for flat terrain with light tree densities, producing the lowest path loss.

Custom: It is also possible to create a custom profile in the WiMAP-4G settings. This is only recommended for experienced users, who know the used parameters exactly and can handle them correctly.



For Community-Edition users, the calculation cannot be more precise than 50 m, which is usually enough to get an overview but not enough for a precise calculation.



The dialog box is titled "Calculation". It contains the following sections:

- Category:** Potential Customer (dropdown)
- Model:** Erceg Model (dropdown)
- Type:** Erceg C (dropdown)
- (Flat/light tree density)** (text label)
- Coverage Probability [%]:** 50.00 (text input)
- Columns:**
 - ☒ Calculate Power Level
 - Power Level Column:** Power Level (dropdown)
 - ☐ Calculate Field Strength
 - Field Strength Column:** Field Strength (dropdown)
 - ☒ Use Height (AGL) Column
 - Height (AGL) Column:** Height (dropdown)
- Carrier:**
 - ☒ Restrict To: WLAN 2.4 GHz (dropdown)

Buttons: OK, Cancel

Figure 347: Choose the type that fits the situation

The coverage probability has to be set. It can be set to a standard value in the WiMAP-4G settings. The function of that value is a little bit tricky to understand. It describes the chance that - considering all circumstances - a specific point receives the calculated field strength in real terms. The coverage is always based on probability theory and cannot be guaranteed 100 % of the time. This probability may be affected by weather or atmospheric conditions. For high frequency carriers the weather can make the little difference between a working and a useless signal. The temperature is able to affect the coverage, too. Depending on this, it is always recommended to set this value not too low. The calculation result may look very nice in theory, but in reality none of the customers may receive a satisfying signal. A good result with a high value as for example 70 % is a good basis for a real project.

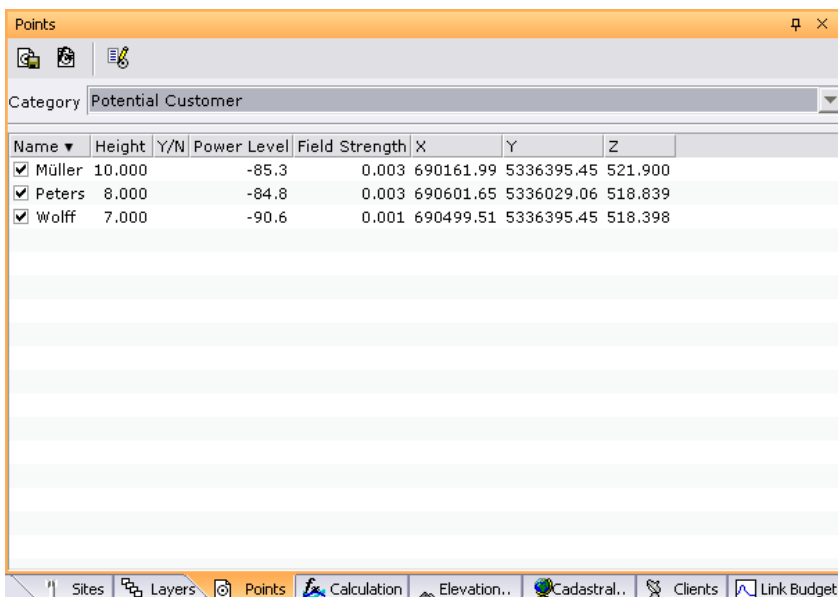


Figure 348: 50 % coverage probability

For example the rectangle in Figure 348 has a 50 % chance for this area receiving a signal, which can be demodulated with QAM 64.



To change the model parameters or the standard coverage probability, see chapter 3.1.2.2.3.



Name	Height	Y/N	Power Level	Field Strength	X	Y	Z
✓ Müller	10.000		-85.3	0.003	690161.99	5336395.45	521.900
✓ Peters	8.000		-84.8	0.003	690601.65	5336029.06	518.839
✓ Wolff	7.000		-90.6	0.001	690499.51	5336395.45	518.398

Figure 349: A point field strength calculation example: Munich, Erceg A, coverage probability: 50 %, resolution: absolute 5 m

10.4.1.2 With the CORLA Raylauncher Model

3.2.1 The CORLA Raylauncher settings which can be made during a point field strength calculation are limited. First of all, the **precision** in X-/Y-direction and in Z-direction can be set in meter. Note that a higher precision always requires more time for calculation. This can take hours or even days if the project is large. So keep in mind to run a test calculation with a low precision first. Nothing is more frustrating than to calculate a project for a few hours when the result looks bad because something has been overlooked.

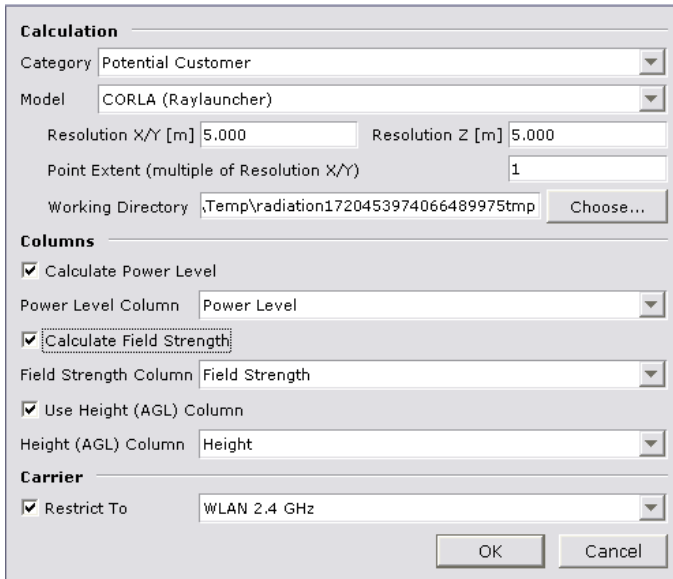


Figure 350: Point field strength calculation settings for CORLA

3.2.2 Choose a **working directory** for CORLA.

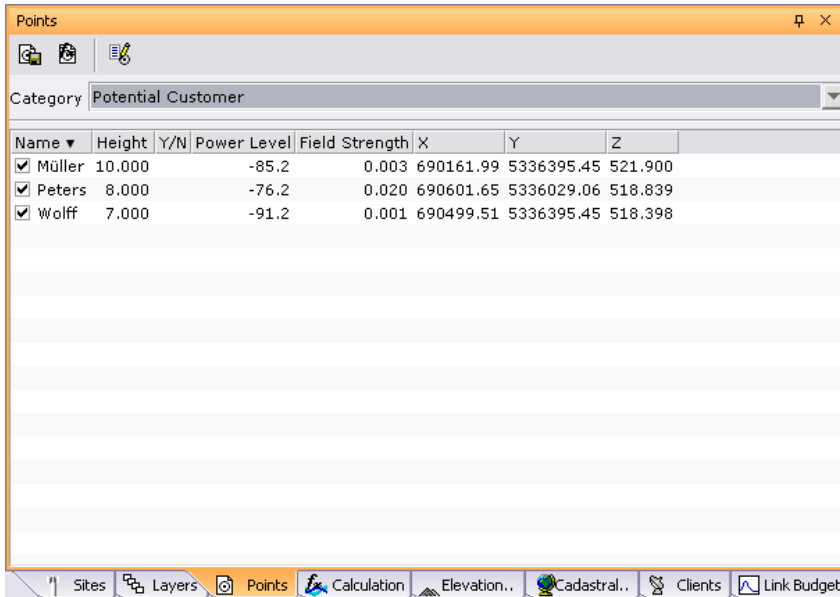
Usually it does not need to be edited. CORLA only needs to create a few temporary files while calculating.



To configure the CORLA Raylauncher, see chapter 3.1.2.3.



Note that the CORLA Raylauncher needs a license for a specific environment and can only be used by Professional-Edition users.

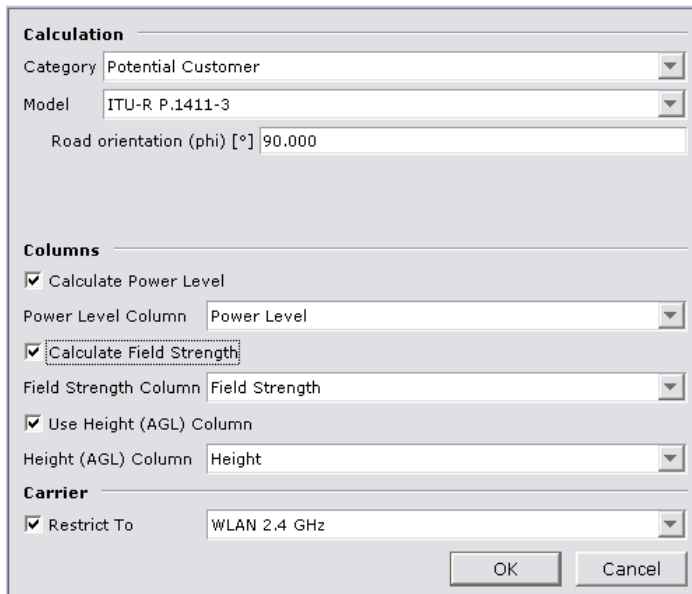


Name	Height	Y/N	Power Level	Field Strength	X	Y	Z
✓ Müller	10.000		-85.2	0.003	690161.99	5336395.45	521.900
✓ Peters	8.000		-76.2	0.020	690601.65	5336029.06	518.839
✓ Wolff	7.000		-91.2	0.001	690499.51	5336395.45	518.398

Figure 351: A point field strength calculation example: Munich, CORLA, resolution x/y: 3, resolution z: 3, point extent: 1

10.4.1.3 With the ITU-R P.1411-3 Model

Choose the **average road orientation** in °. This can be set to a standard value in the settings.



Calculation

Category: Potential Customer

Model: ITU-R P.1411-3

Road orientation (phi) [°]: 90.000

Columns

☒ Calculate Power Level

Power Level Column: Power Level

☒ Calculate Field Strength

Field Strength Column: Field Strength

☒ Use Height (AGL) Column

Height (AGL) Column: Height

Carrier

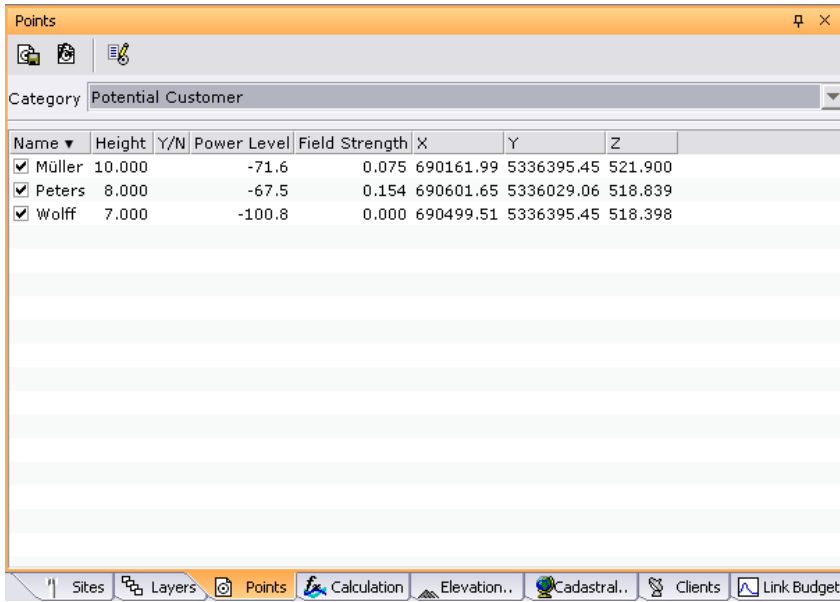
☒ Restrict To: WLAN 2.4 GHz

OK Cancel

Figure 352: Point field strength calculation settings for ITU-R P.1411-3



To configure the ITU-R P.1411-3, see chapter 3.1.2.2.2.



Name	Height	Y/N	Power Level	Field Strength	X	Y	Z
✓ Müller	10.000	-71.6	0.075	690161.99	5336395.45	521.900	
✓ Peters	8.000	-67.5	0.154	690601.65	5336029.06	518.839	
✓ Wolff	7.000	-100.8	0.000	690499.51	5336395.45	518.398	

Figure 353: A point field strength calculation example: Munich, ITU-R P.1411-3, road orientation: 90°

10.4.1.4 With the Free Space Propagation Model

The Free Space Propagation Model is the easiest model, it does not need any parameters.

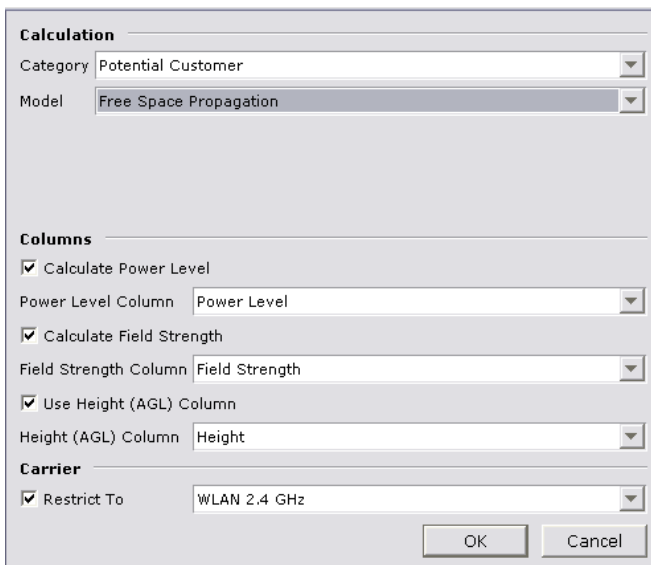
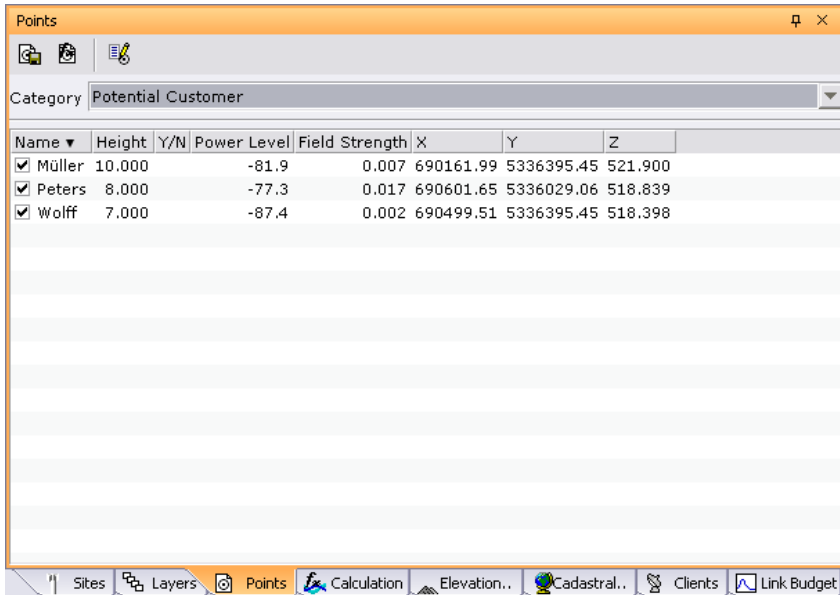


Figure 354: Point field strength calculation settings for Free Space Propagation



To configure the Free Space Propagation Model, see Chapter 3.1.2.2.1.

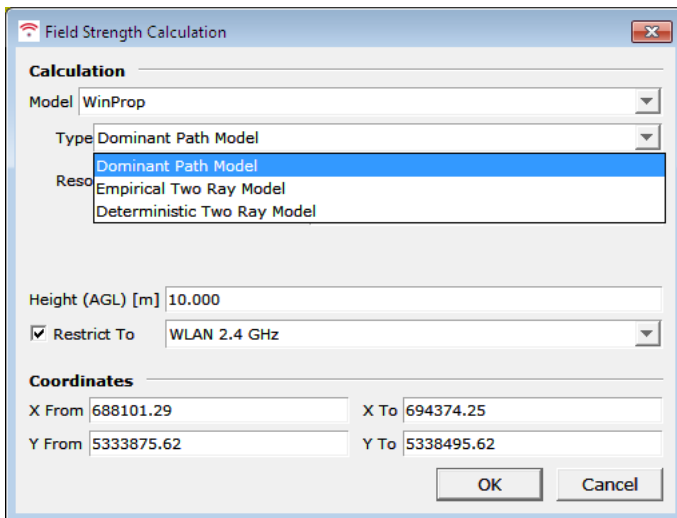


Name	Height	Y/N	Power Level	Field Strength	X	Y	Z
✓ Müller	10.000		-81.9	0.007	690161.99	5336395.45	521.900
✓ Peters	8.000		-77.3	0.017	690601.65	5336029.06	518.839
✓ Wolff	7.000		-87.4	0.002	690499.51	5336395.45	518.398

Figure 355: A point field strength calculation example: Munich, Free Space Propagation

10.4.1.5 With WinProp

WinProp is for propagation modeling in different scenarios with different model types of calculation.



Field Strength Calculation

Calculation

Model: WinProp

Type: Dominant Path Model

Reso: Dominant Path Model, Empirical Two Ray Model, Deterministic Two Ray Model

Height (AGL) [m]: 10.000

☒ Restrict To: WLAN 2.4 GHz

Coordinates

X From: 688101.29 X To: 694374.25

Y From: 5333875.62 Y To: 5338495.62

OK Cancel

Figure 356: WinProp field strength calculations settings

The **Dominant Path Model** calculates the main paths between transmitter and each receiver pixel by high precision like the ray tracing.

The **Empirical Two Ray Model** calculates the path loss by each pixel on the map, without looking if the point is hidden or unreachable.

The **Deterministic Two Ray Model** calculates the path loss by each pixel on the map with checking whether the point is not hidden and reachable.



A special license is needed to use WinProp models, which can be ordered at WIMAP-4G product support (info@brown-iposs.eu).

10.4.1.6 General Settings

After choosing and configuring the desired propagation model, there are a few settings that have to be done for all models. The values which should be calculated can be chosen at the bottom of the window.

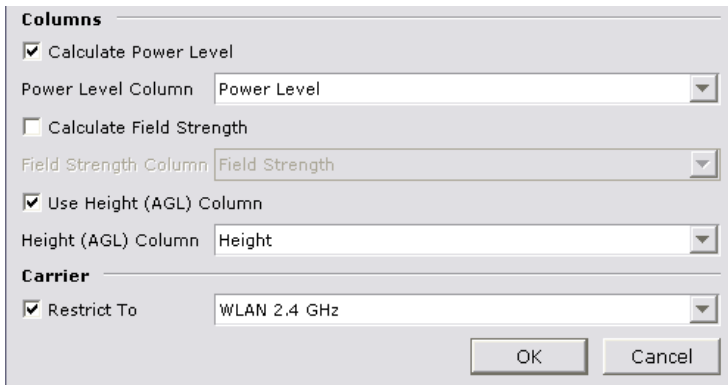


Figure 357: General settings for point field strength calculation

Make sure to *assign the calculated **value** to the correct point category column*. For the height column, choose the height column that is used from the points. Do not use the Z column because this will distort the results.

*At last, choose the carrier for the calculation and press **OK** to start the calculation.*

10.4.2 Compare all Propagation Models

With the help of the point categories it is also possible to compare the propagation models. A propagation model may give good results whereas another does not offer good results for a special case. With some modifications the results of all propagation models can be compared to make a decision.

10.4.2.1 How to Use all Propagation Models for a Point Field Strength Calculation

1. Choose **Points** → **Edit Categories**.



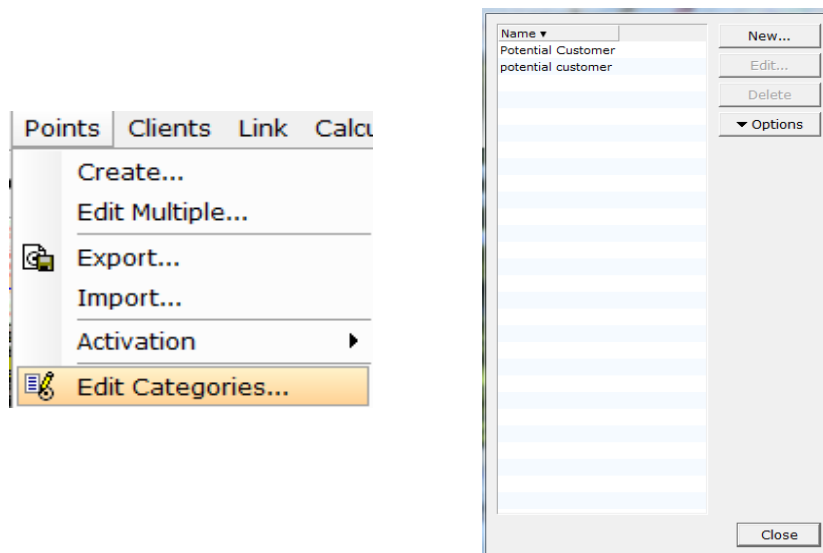


Figure 358: Open the point category settings

2. Choose the desired point category (in this case Potential Customer was chosen). Add columns for all propagation models.



To edit point classes see chapter 9.1.1 and 9.1.2.

3. The result should look like this:

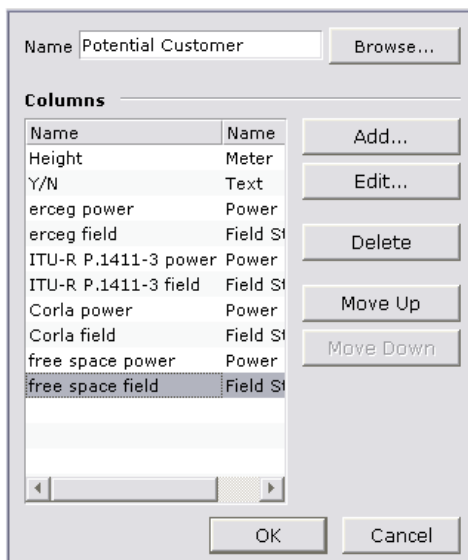
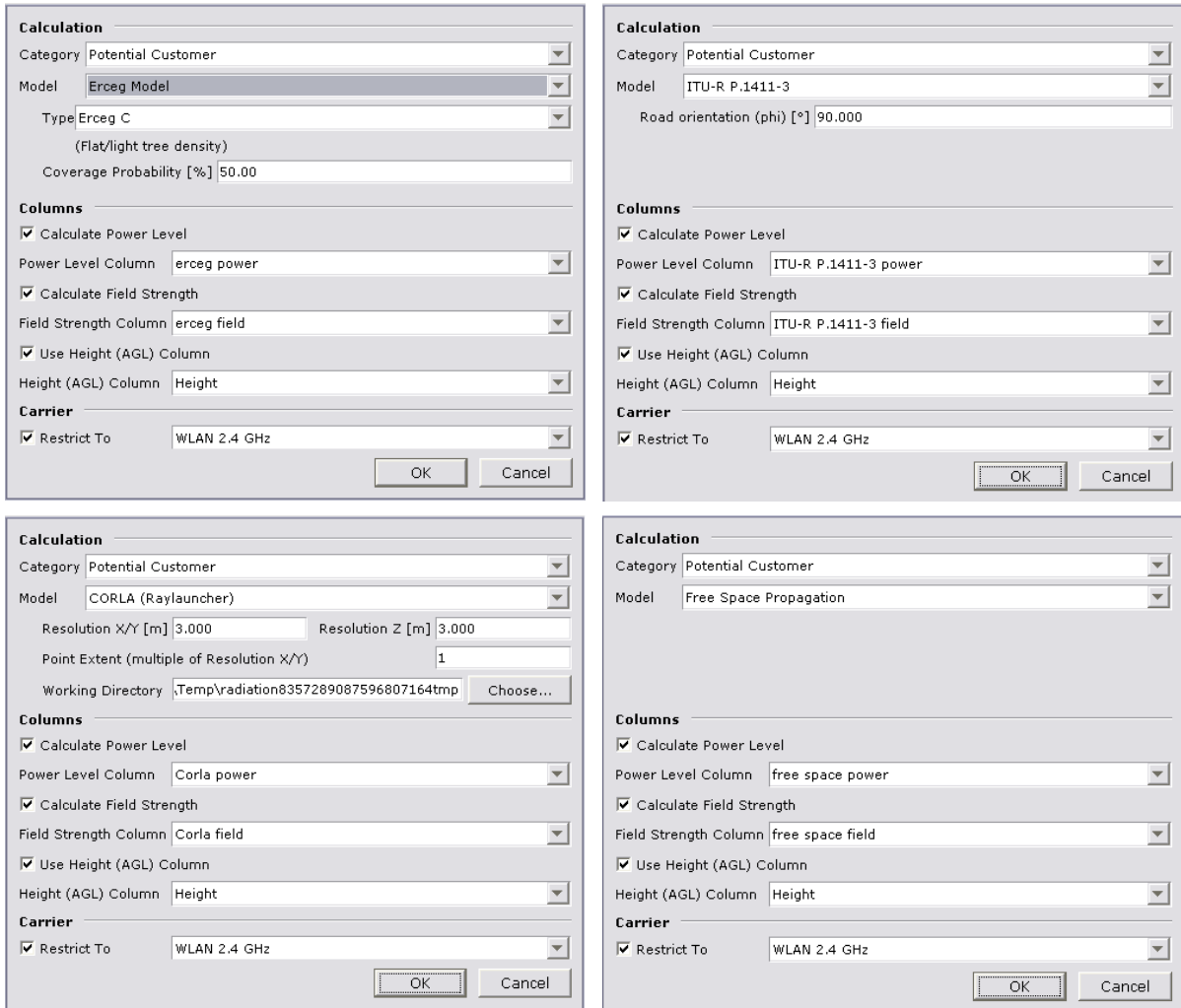


Figure 359: Columns for all propagation models

4. Click on **OK**, close all windows and return to the project.

5. Choose **Calculation**→**Point Field Strength Calculation** and make a calculation for every model.

Make sure to choose the right column at the bottom of the window and start the calculations.



The figure displays four screenshots of the 'Calculation' dialog box, arranged in a 2x2 grid. Each dialog box is for a different propagation model and has the same general structure:

- Category:** Potential Customer
- Model:** (varies by screenshot)
- Type:** (varies by screenshot)
- Coverage Probability [%]:** 50.00
- Columns:**
 - ☒ Calculate Power Level
 - ☒ Calculate Field Strength
 - ☒ Use Height (AGL) Column
- Carrier:**
 - ☒ Restrict To: WLAN 2.4 GHz
- Buttons:** OK, Cancel

Screenshot 1 (Top Left): Model: Erceg Model, Type: Erceg C (Flat/light tree density).

Screenshot 2 (Top Right): Model: ITU-R P.1411-3, Road orientation (phi) [°]: 90.000.

Screenshot 3 (Bottom Left): Model: CORLA (Raylauncher), Resolution X/Y [m]: 3.000, Resolution Z [m]: 3.000, Point Extent (multiple of Resolution X/Y): 1, Working Directory: .Temp\radiation8357289087596807164tmp.

Screenshot 4 (Bottom Right): Model: Free Space Propagation.

Figure 360: Make point field strength calculations for every propagation model

6. All columns are shown in the points tab of the Project-Explorer. Results can be compared after doing all calculations.

Points

List | Coverage | Visualisation

Category Potential Customer

Name	Corla power	Corla field	ITU-R P.1411-3 power	ITU-R P.1411-3 field	free space power	free sapce fi...	erceg po...	erceg fi...	X
☒ Müller	-92.2	0.001	-83.7	0.005	-91.5	0.001	-105.8	0.000	690161.99
☒ Peters ...	-85.2	0.003	-112.7	0.000	-82.2	0.006	-99.5	0.000	690601.65
☒ Wolff ...	-104.2	0.000	-108.4	0.000	-81.8	0.006	-94.2	0.000	690499.51

Figure 361: Comparison of the propagation models

10.5 The Site to Site Calculation

The **Site to Site Calculation** feature calculates the pathloss between two antennas. This can be useful to determine whether two antennas can cooperate in a specific area or not.



10.5.1 How to Make a Site to Site Calculation

There are a few requirements to make a site to site calculation successful. Possibly the most common reason to get a bad result respectively no result in a site to site calculation is when both antennas use the same carrier. Another source of errors is the angle between two antennas.

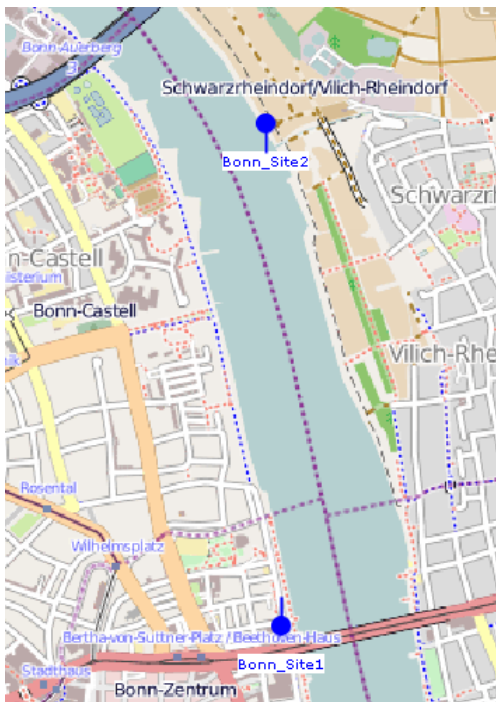


Figure 362: Example for a site to site calculation

1. There are two possibilities to make a site to site calculation:
 - Choose **Calculation→Site-to-Site**.

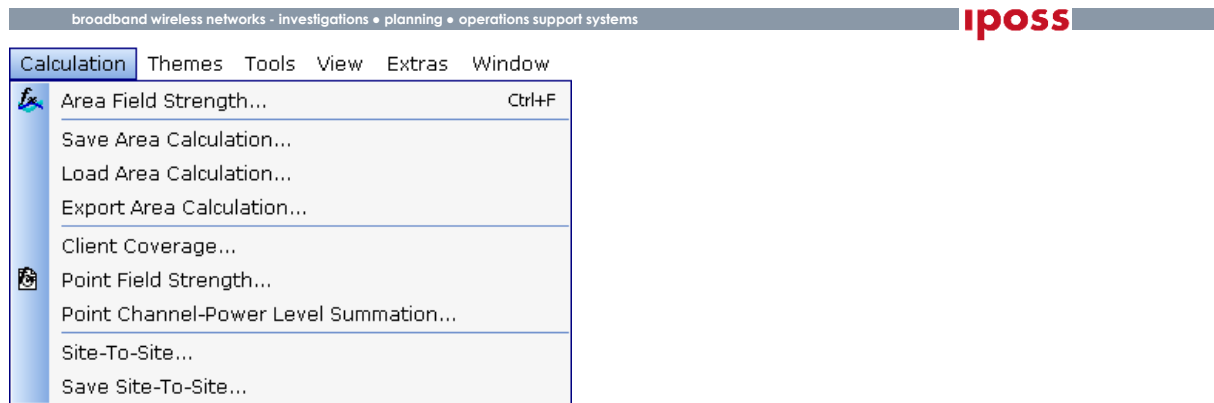


Figure 363: Start site to site calculation

- Right click on a site on the map and choose **Site-to-Site Calculation**.

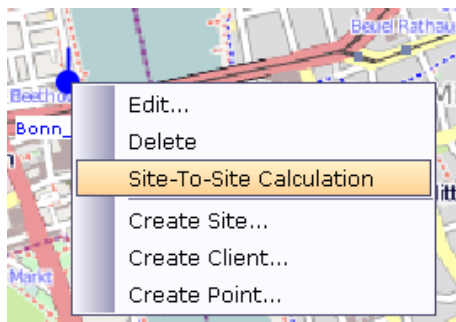


Figure 364: Start site to site calculation from the map

2. The Site-to-Site calculation window opens:

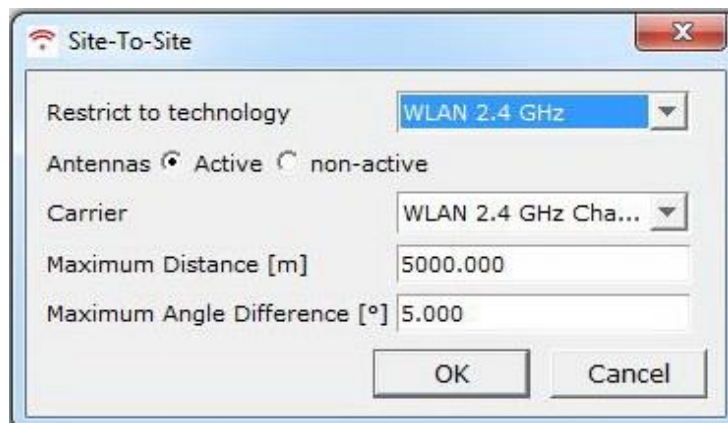


Figure 365: The site to site calculation settings

3. Choose **technology** and **carrier** used by the desired antennas, select if the antennas are **active** or **non-active** and insert **maximum distance** and **maximum angle difference** and click on **OK**.

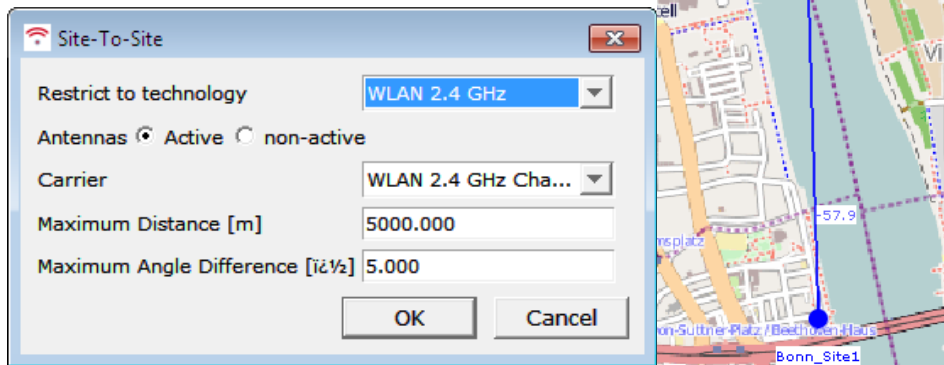


Figure 366: Fill in all the fields and click OK to start the calculation.

The pathloss will be shown beside the line which connects the antennas. In this case it is -57.9 dB.

Figure 367 shows a few antennas involved in a site to site calculation. If a blue line connects antennas after doing a site to site calculation, everything worked out fine. If a black line is shown, the antenna is not placed well. Take a look at the environment with the help of the **Terrain-Profiler** to find out what happened. In most cases a mountain or a building interferes the connection.

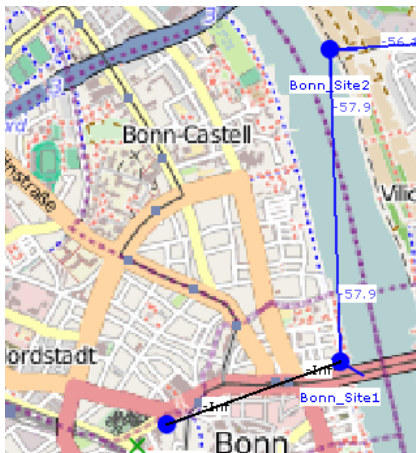


Figure 367: A black line signalizes problems

10.6 The Coverage Theme

This theme is the basic theme used by the field strength area calculation. The coverage theme provides a margin that can be determined for the project. It is a useful feature to run some tests to find out how the coverage changes by using different margins.



Note that the coverage theme will be created at that height the field strength area calculation was made.



10.6.1 How to Create a Coverage Theme

1. Make a field strength area calculation.

(A more precise calculation offers a better overview but takes more time to calculate.)



To make a field strength area calculation see chapter 10.2.1.

2. There are three possibilities to create a coverage theme:

- Choose **Themes→Coverage→Display**.

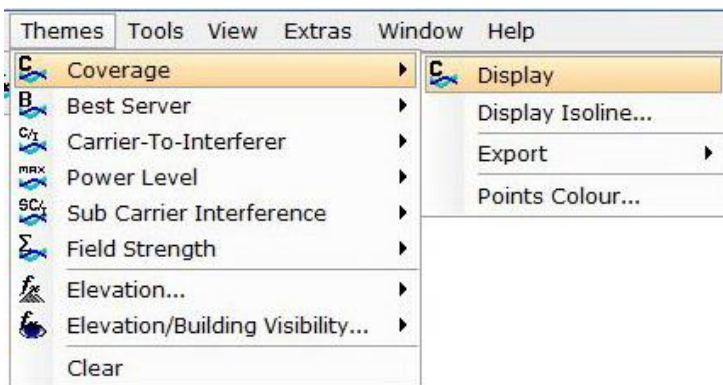


Figure 368: Create coverage theme from menu

- Choose the **Calculation tab** in the **Project-Explorer** and click on  .

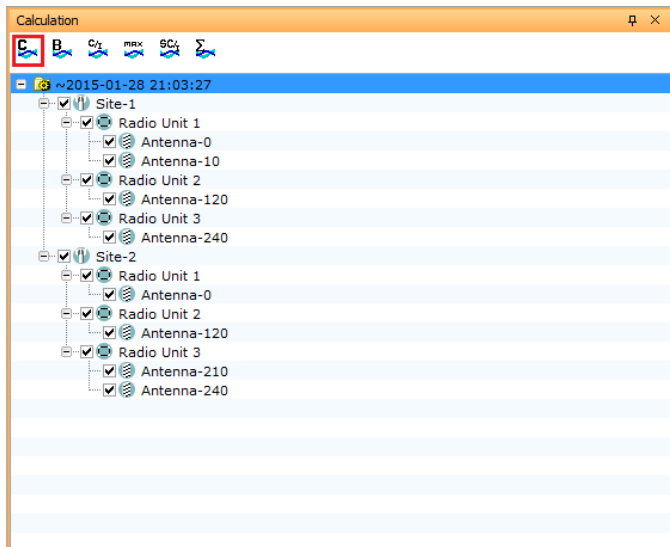


Figure 369: Create coverage theme from Calculation tab

- Choose the **Calculation tab** in the **Project-Explorer**, right-click and choose **Coverage**.

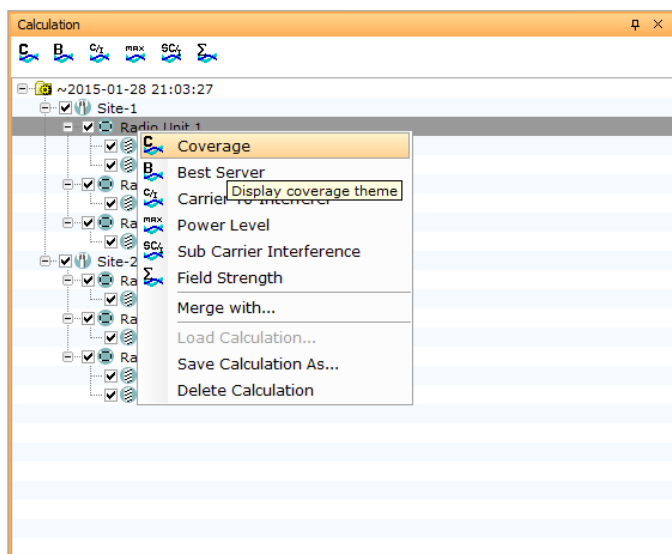
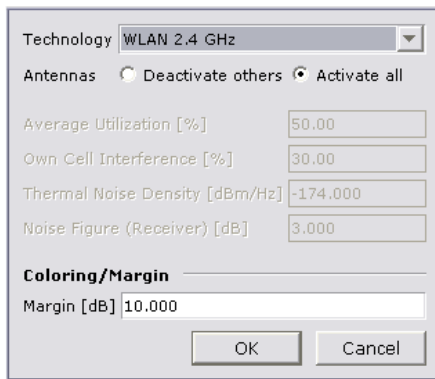


Figure 370: Create coverage theme from Calculation tab by right-clicking antennas

3. The coverage theme window opens:



Technology: WLAN 2.4 GHz

Antennas: ☐ Deactivate others ☒ Activate all

Average Utilization [%]: 50.00

Own Cell Interference [%]: 30.00

Thermal Noise Density [dBm/Hz]: -174.000

Noise Figure (Receiver) [dB]: 3.000

Coloring/Margin

Margin [dB]: 10.000

OK Cancel

Figure 371: Coverage theme settings

4. Choose to create the theme for **all antennas** or only for the **actual antenna**. (Only works by right-clicking on antennas in the **Project-Explorer** and choosing **Coverage** or marking the antennas and clicking on ). WiMAP-4G will automatically assign the grayed values.

5. Choose a **margin** and click on **OK**.

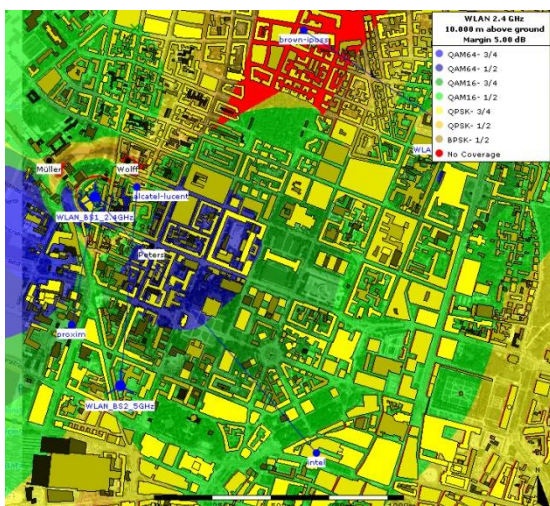


Figure 372: A coverage theme example: Munich, 10 dB margin

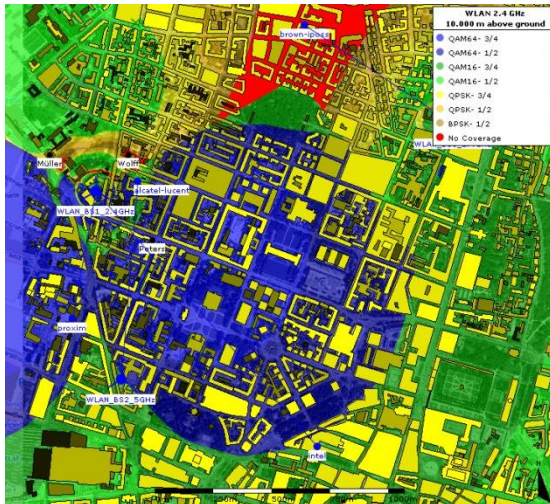


Figure 373: A coverage theme example: Munich, 0 dB margin

10.7 The Best Server Theme

Learned from its name, the best server theme shows the antenna that offers the best signal for a specific area. In most cases, the nearest antenna is not the best choice for a customer. A few circumstances, for example the environment and the buildings, need to be considered while calculating the best antenna. WiMAP-4G offers the best server theme to maintain the best signal for a specific area. The best server theme needs a field strength area calculation to offer results.



Note that the best server theme will be created at that height the field strength area calculation was made.



10.7.1 How to Create a Best Server Theme

1. *Make a field strength area calculation.*
(A more precise calculation offers better overview but takes more time to calculate.)



To make a field strength area calculation see chapter 10.2.1.

2. There are three possibilities to create a best server theme:
 - Choose **Themes**→**Best Server**→**Display**.

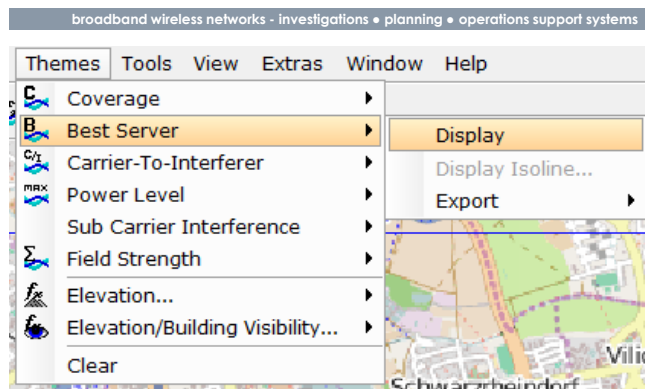


Figure 374: Create best server theme from menu

- Choose the **Calculation** tab in the **Project-Explorer** and click on  .

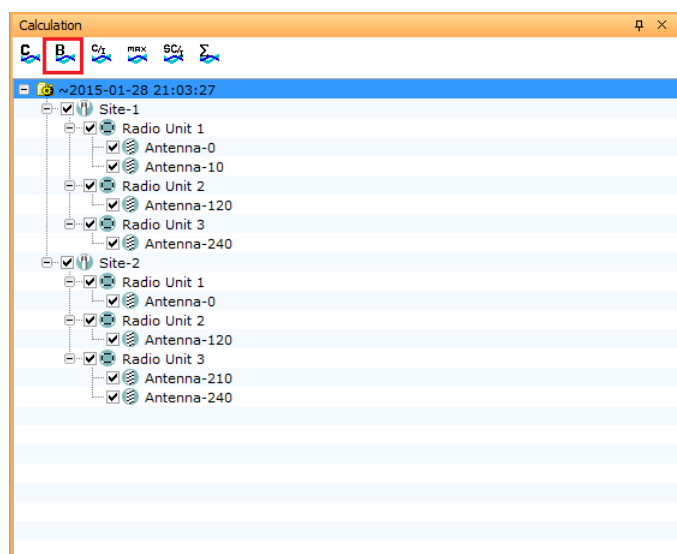


Figure 375: Create best server theme from calculation tab

- Choose the **Calculation** tab in the **Project-Explorer**, right-click and choose **Best Server**.

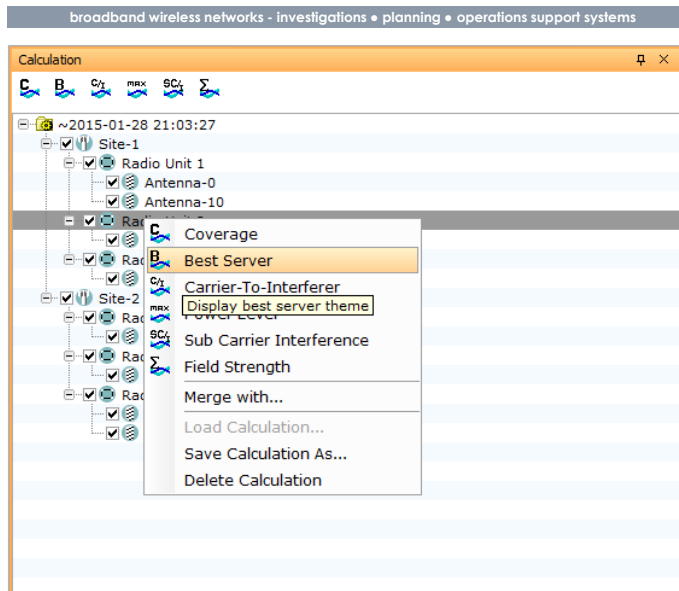


Figure 376: Create best server theme from calculation tab by right-clicking antennas

3. The best server theme window opens:

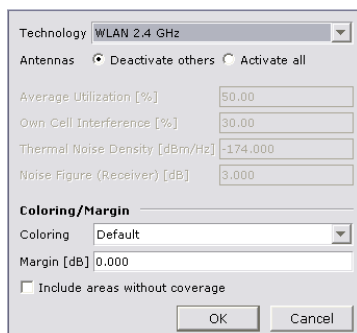


Figure 377: Best server theme settings

4. Choose to create the theme for **all antennas** or only for the **actual antenna**. (Only works by right-clicking on antennas in the Project-Explorer and choosing **Best Server** or marking the antennas and clicking on .)

5. Choose a **colour profile** and a **margin**.

Including areas without coverage forces WiMAP-4G to calculate the theoretical best server for that area assuming there would be coverage. (If the **included area without coverage** option is enabled, the **margin** will be ignored.)



To change colour profiles, see chapter 3.1.2.1.1.

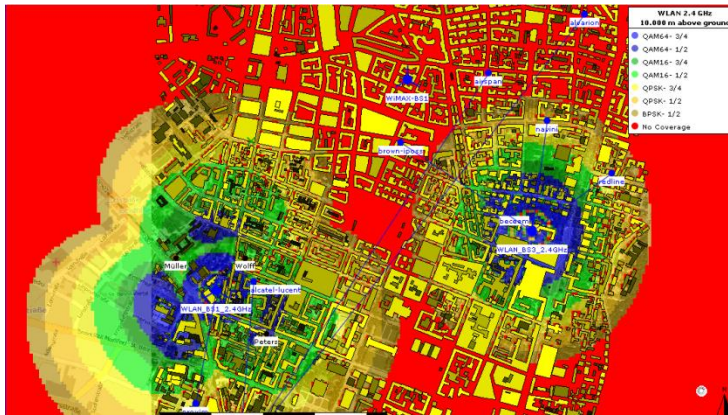


Figure 378: Munich: Field strength area calculation Erceg A



Figure 379: A best server theme example: Munich, 10 dB margin

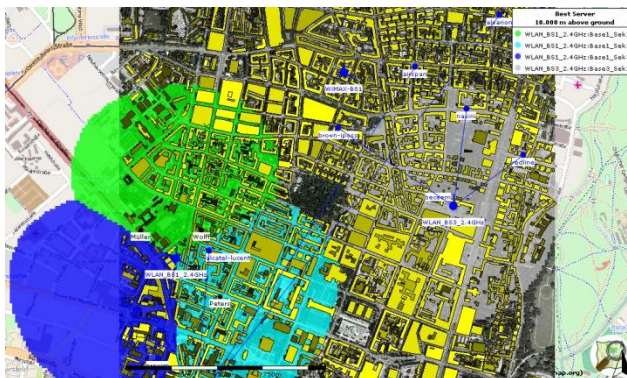


Figure 380: A best server theme example: Munich, 0 dB margin

10.8 The Carrier to Interferer Theme

The **carrier to interferer theme** is a useful feature of WiMAP-4G to detect uncovered areas on the map because of interference between antennas. If two antennas use the same carrier at the same frequency and power they interfere with each other. This could end in a complete signal loss. WiMAP-4G shows the ratio between carrier signal and interference signal. The minimal value acceptable as a result of a carrier to interference theme depends

on the used technology. Areas that offer a carrier to interference below 0 mostly do not receive a useable signal. For example, for LTE and a QAM64 modulation a minimum ratio of 10 is required.



Note that the carrier to interferer is based on the field strength area calculation done before and is limited to its parameters (e.g. calculation height).



10.8.1 How to Create a Carrier to Interferer Theme

1. Make a field strength area calculation.

(A more precise calculation offers better overview but takes more time to calculate.)



To make a field strength area calculation see chapter 10.2.1.

2. There are three possibilities to create a carrier to interferer theme:

- Choose **Themes**→**Carrier to Interferer**→**Display**.

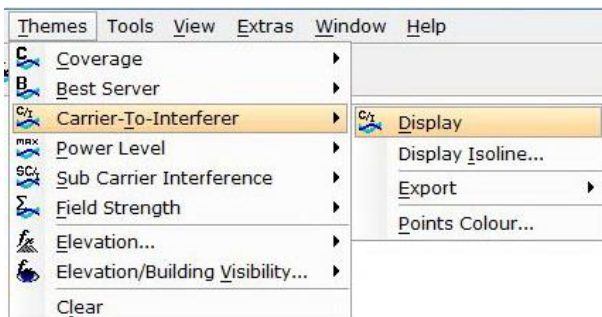


Figure 381: Create carrier to interferer theme from menu

- Choose the **calculation tab** in the **Project-Explorer** and click  .

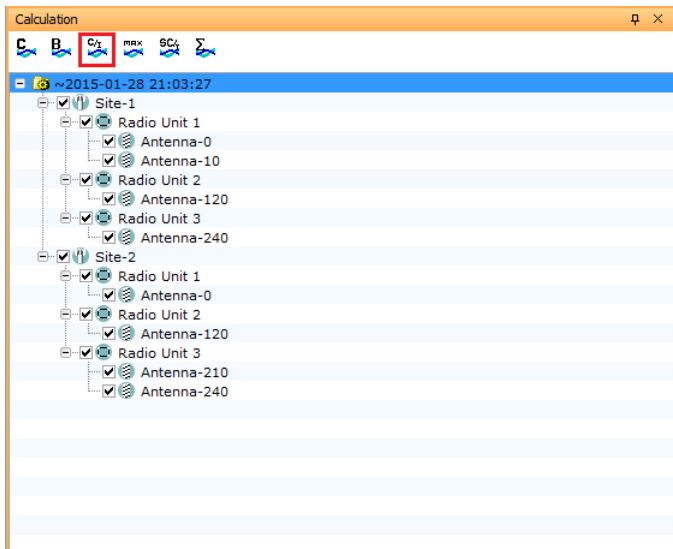


Figure 382: Create carrier to interferer theme from calculation tab

- Choose the **calculation tab** in the **Project-Explorer**, right-click and choose **Carrier-To-Interferer**.

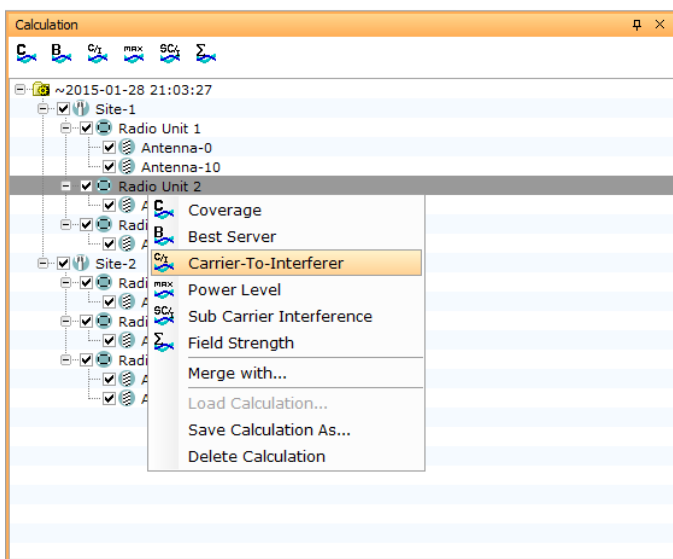
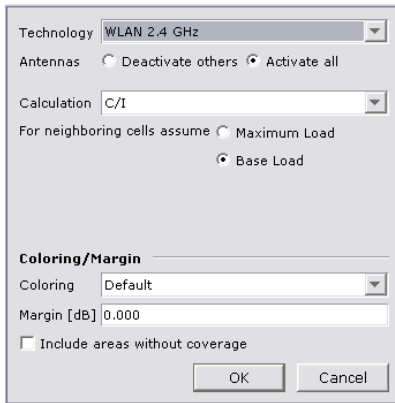


Figure 383: Create carrier to interferer theme from calculation tab by right-clicking antennas

3. The carrier-to-interferer theme window opens:



Technology: WLAN 2.4 GHz

Antennas: ☐ Deactivate others ☒ Activate all

Calculation: C/I

For neighboring cells assume: ☐ Maximum Load ☒ Base Load

Coloring/Margin

Coloring: Default

Margin [dB]: 0.000

☐ Include areas without coverage

OK Cancel

Figure 384: Carrier-to-interferer theme settings

4. Choose to create the theme for **all antennas** or only for the **actual antenna**. (Only works by right-clicking on antennas in the Project-Explorer and choosing Carrier-to-Interferer or marking the antennas and clicking on  .)

5. Choose a **colour profile** and a **margin**.



To change colour profiles, see chapter 3.1.2.1.1.

The sites can run in maximum load or base load modus during a calculation.

Choose one of them.

The maximum load is default because in extreme situations the ratio is always more significant than it would be in base load situations. Including areas without coverage forces WiMAP-4G to show the theoretical carrier-to-interferer value for an area assuming there would be coverage. (If the included area without coverage option is enabled, the margin will be ignored.)

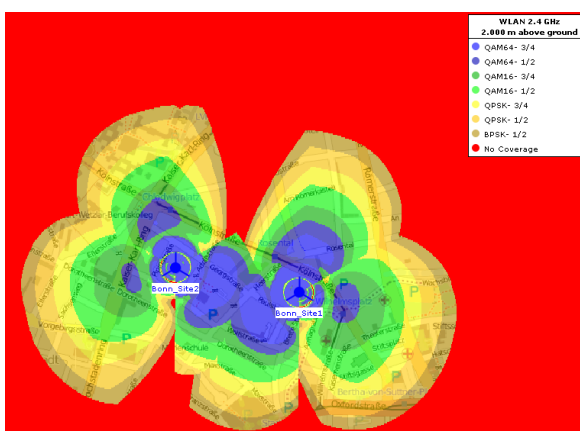


Figure 385: Field strength area calculation Erceg A

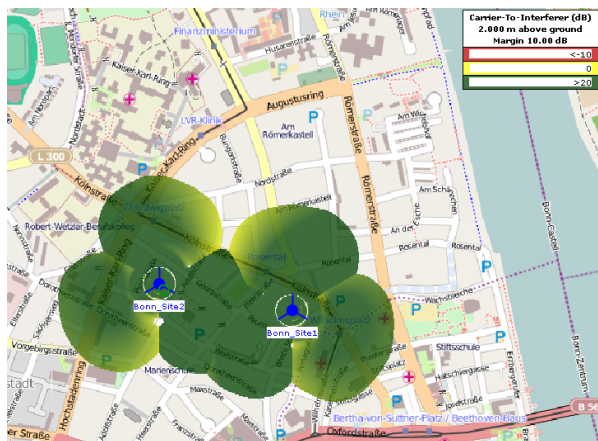


Figure 386: A carrier-to-interferer theme example: 10 dB margin

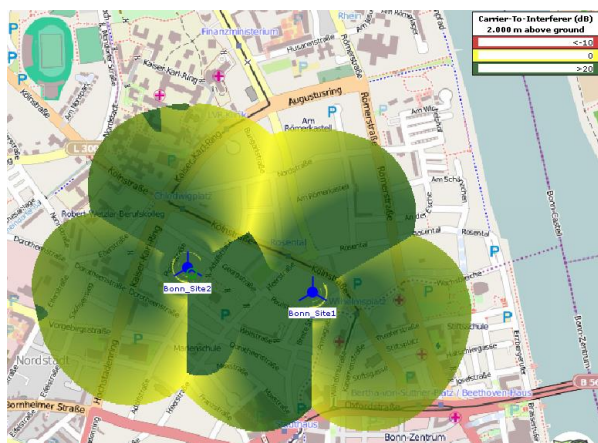


Figure 387: A carrier-to-interferer theme example: 0 dB margin

As described in the legend, the yellow areas on the map do not have a usable signal. Green zones are more efficient.

A little green circle on the map marks the area with the best carrier to interference ratio.
Drag the mouse cursor over that circle to show the ratio.

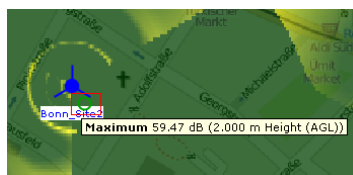


Figure 388: Marker for the best C/I

10.9 The Power Level Theme

The **power level theme** helps to determine the exact values for the power level in specific areas. Another way to show those values are points used to calculate the power level. Points only show the power level on a precise point on the map whereas the power level theme shows the power level for all zones that are covered by a carrier.



Note that the power level theme will be created at that height the field strength area calculation was made.



10.9.1 How to Create a Power Level Theme

1. *Make a field strength area calculation.*
(A more precise calculation offers a better overview but takes more time to calculate.)



To make a power field strength area calculation see chapter 10.2.1.

2. There are three possibilities to create a power level theme:

- Choose **Themes**→**Power Level**→**Display**.

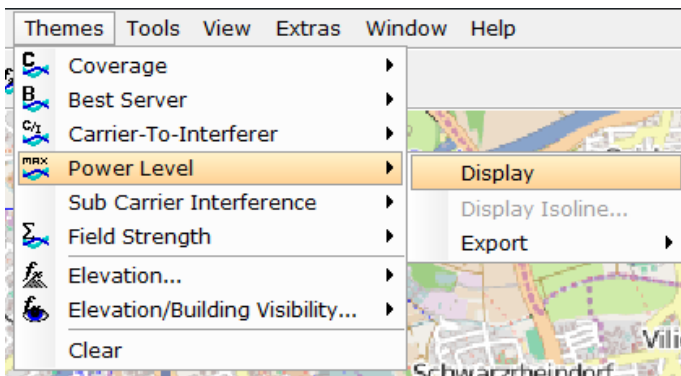


Figure 389: Create power level theme from menu

- Choose the **calculation tab** in the **Project-Explorer** and click on  .

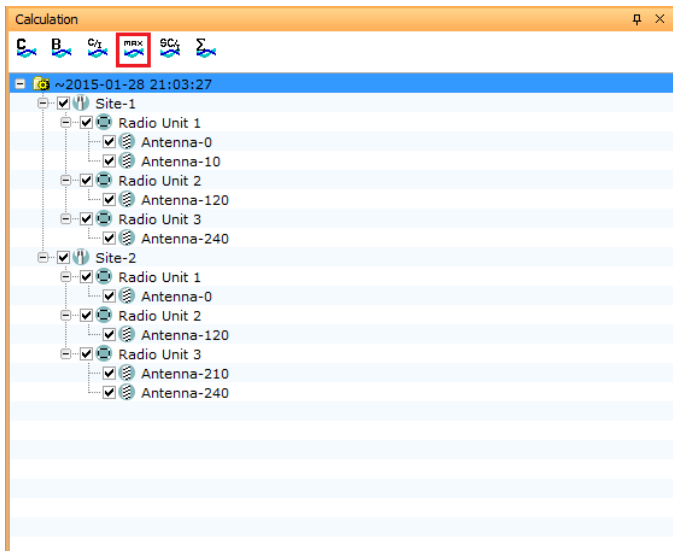


Figure 390: Create power level theme from calculation tab

- Choose the **calculation tab** in the **Project-Explorer**, right-click and choose **Power Level**.

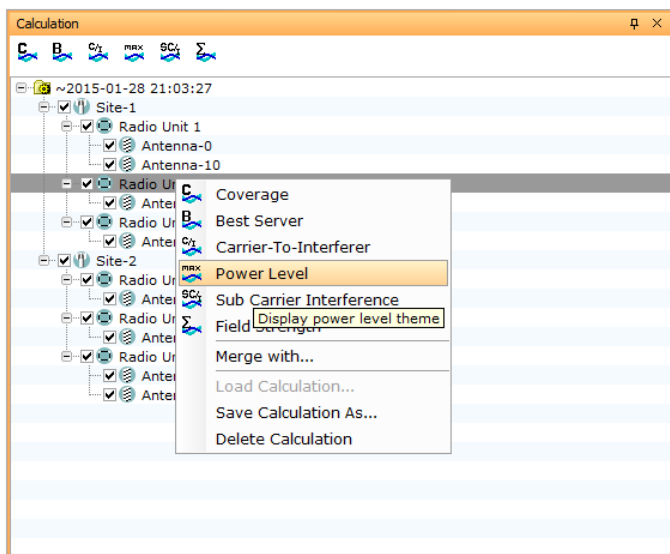


Figure 391: Create power level theme from calculation tab by right-clicking antennas

3. The power level theme window opens:

☐ Use antennas as activated
☒ Restrict to technology WLAN 2.4 GHz
 Antennas ☐ Deactivate others ☒ Activate all
Coloring/Margin
 Coloring Default
 Margin [dB] 0.000
 OK Cancel

Figure 392: Power level theme settings

4. Choose to create the theme for **all activated antennas** or only a **specific technology**. If the theme is restricted to a specific technology, choose whether the actual antenna or all antennas with that technology should be shown (only works with right-clicking on antennas in the Project-Explorer and choosing Power Level or choosing antenna and clicking  .)

- 5. Choose a *colour profile* and a *margin*.**



To change the colour profiles see chapter 3.1.2.1.1.



Figure 393: Munich: Field strength area calculation Erceg A

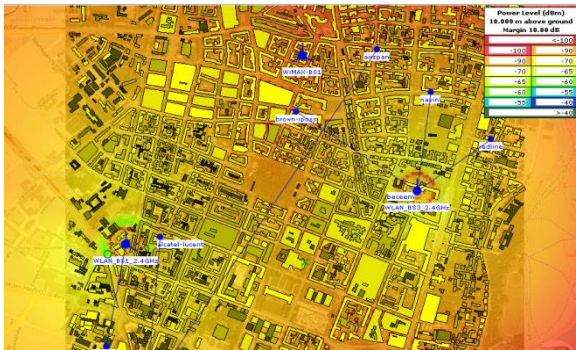


Figure 394: A power level theme example: Munich, 10 dB margin



Figure 395: A power level theme example: Munich, 0 dB margin

In this example, the colour profile has been modified to visualize the differences. A little green circle on the map marks the area with the best power level.

Drag the mouse cursor over that circle to see the exact power.

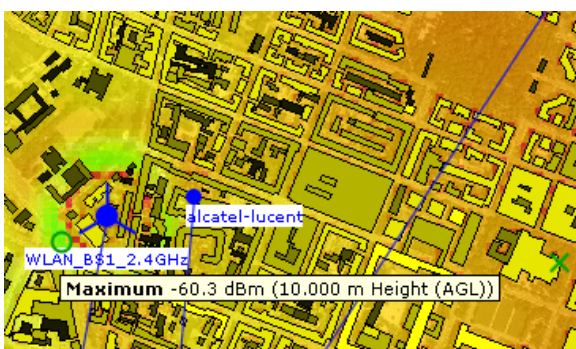


Figure 396: Marker for the best power level

10.10 The Sub-Carrier Interference Theme

The **sub-carrier interference theme** is a useful tool to explore the interference for any activated sub-carrier in the project. The primary benefit is to see the sub-carrier interference of the strongest received signal from an antenna carrying the selected sub-carrier to any in-band interferer in the area of comparison. E.g. if WLAN 2.4 GHz channel 1 is the selected

sub-carrier also interferences from overlapping channels like channel 2 are considered. This feature helps to create a clear footprint for your covering cells.



Note that the sub-carrier interference theme is created at that height the field strength area calculation was made.



10.10.1 How to Create a Sub-Carrier Interference Theme

1. *Make a field strength area calculation.*

(A more precise calculation offers better overview but takes more time to calculate.)



To make a field strength area calculation see chapter 10.2.1.

2. There are two possibilities to create a sub-carrier interference theme:

- Choose **Themes**→**Sub Carrier Interference**→**Display**.

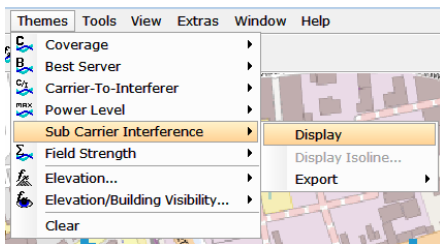


Figure 397: Creating a sub-carrier interference theme from menu

- Choose the **calculation tab** in the **Project-Explorer** and click on .

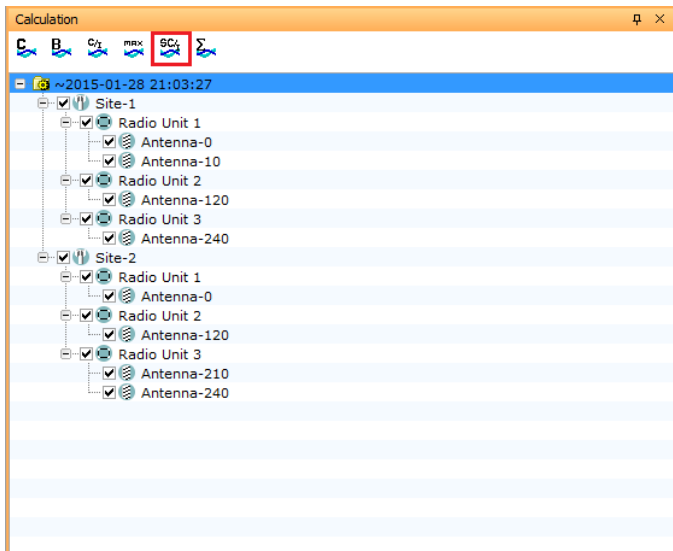


Figure 398: Creating a sub-carrier interference theme from calculation tab

- Choose the **Calculation tab** in the **Project-Explorer**, right-click and choose **Sub Carrier Interference**.

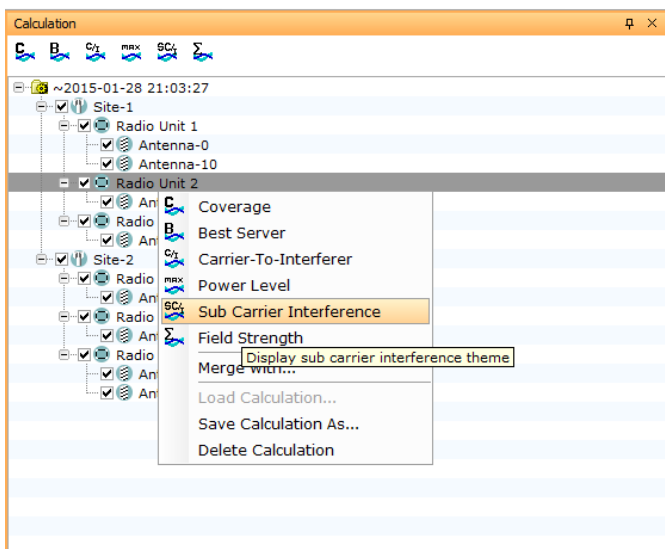


Figure 399: Creating a sub-carrier interference theme from calculation tab by right-clicking antennas

3. The sub-carrier interference theme window opens:

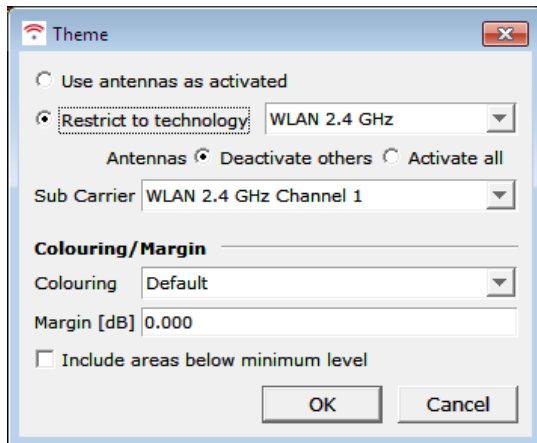


Figure 400: Sub-carrier interference theme settings

4. Choose to create the theme for **all activated antennas** or only for a **specific technology**. If the theme is restricted to a specific technology, choose whether the actual antenna or all antennas with that technology should be shown (only works with right-clicking on antennas in the Project-Explorer and choosing Sub Carrier Interference). Key for this theme is to select the **Sub-Carrier** accordingly.

5. Choose a **colour profile**.



To change colour profiles, see chapter 3.1.2.1.1.

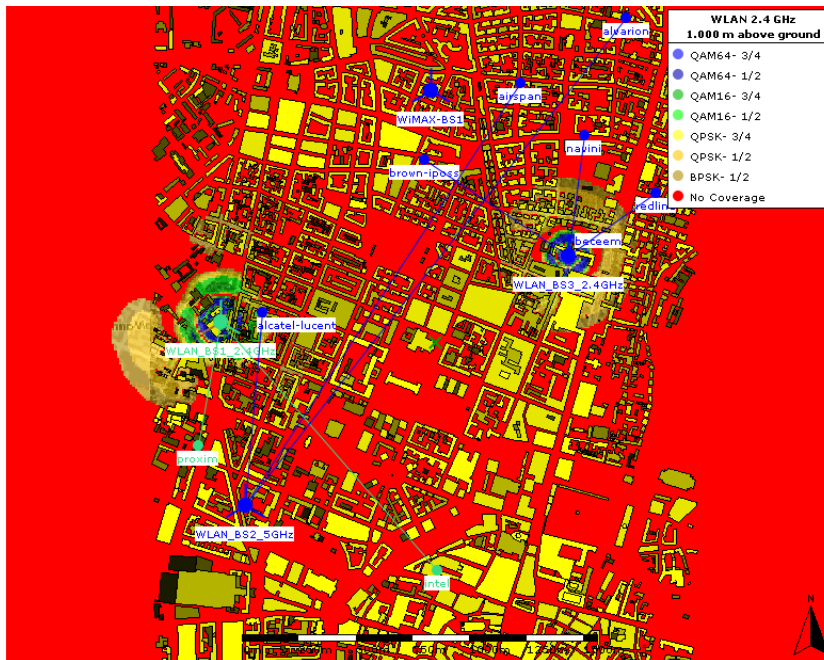


Figure 401: Munich: Field strength area calculation Erceg A

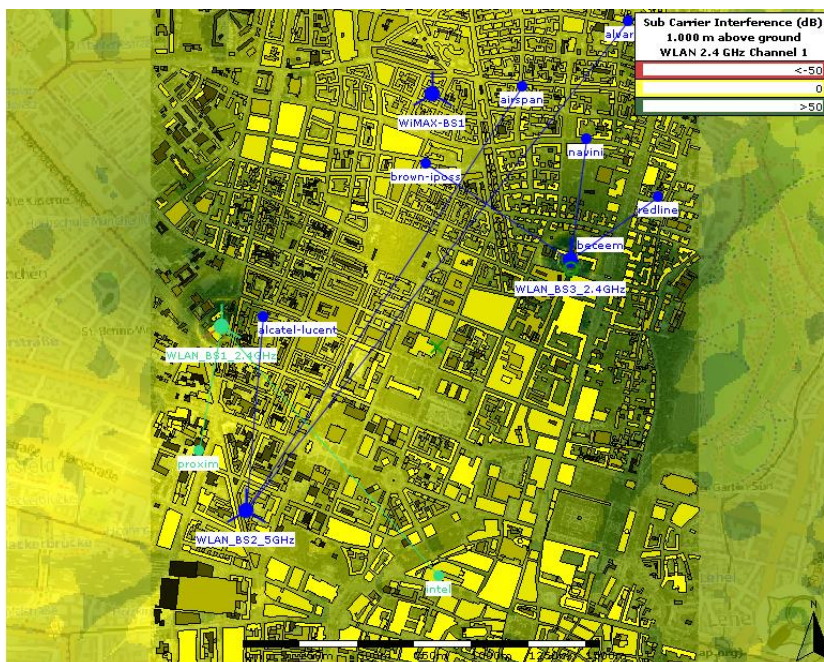


Figure 402: A sub carrier interference theme example: Munich, 0 dB margin

As shown in Figure 402 most of the area is shaded in light green which means that the signal for sub carrier "WLAN 2.4GHz Channel 1" is faced not too much with interference. In contrary to the carrier-to-interference the whole consideration is done for the selected sub-carrier (independent of being the sub-carrier the best server or not). With the help of this theme areas of high interference for a given sub carrier and its carrying frequency can easily be explored.

A little green circle on the map marks the area with the best sub-carrier interference. Drag the mouse cursor over that circle to see the exact power.



Figure 403: Marker for best sub-carrier interference

10.11 The Field Strength Theme

The **field strength theme** is useful to determine for example the power density in a specific area around antennas. This can be used to see if the power density fulfils the conditions given by the specific environment. A high power density can cause damage on human health so a power density theme should always be made to check out the field strength and to see if the critical values do not get exceeded.



Note that the field strength theme is created at that height the field strength area calculation was made.



10.11.1 How to Create a Field Strength Theme

1. *Make a field strength area calculation.*
(A more precise calculation offers better overview but takes more time to calculate.)



To make a field strength area calculation see chapter 10.2.1.

2. There are three possibilities to create a field strength theme:

- Choose **Themes→Field Strength→Display**.

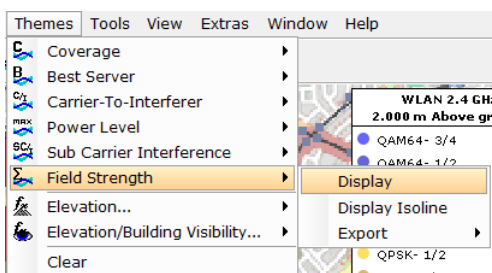


Figure 404: Create field strength theme from menu

- Choose the **calculation tab** in the **Project-Explorer** and click  .

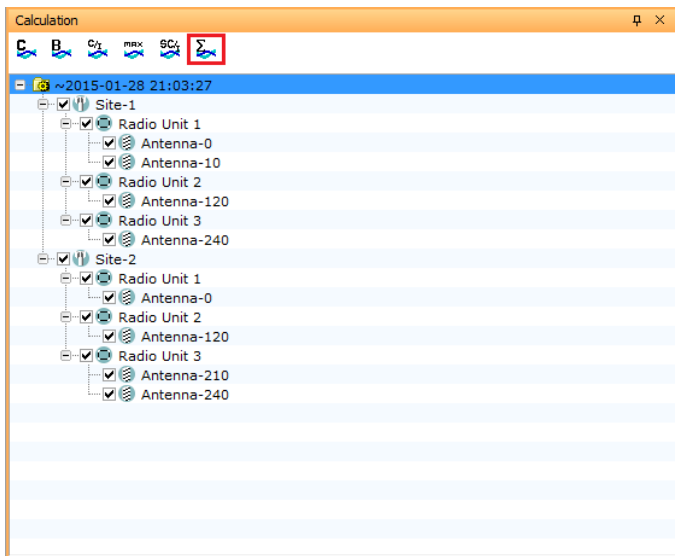


Figure 405: Creating field strength theme from calculation tab

- Choose the **calculation tab** in the **Project-Explorer**, right-click and choose **Field Strength**.

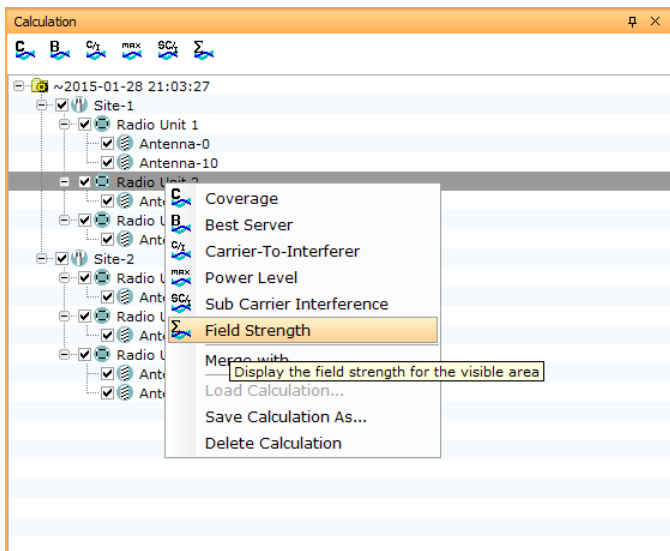
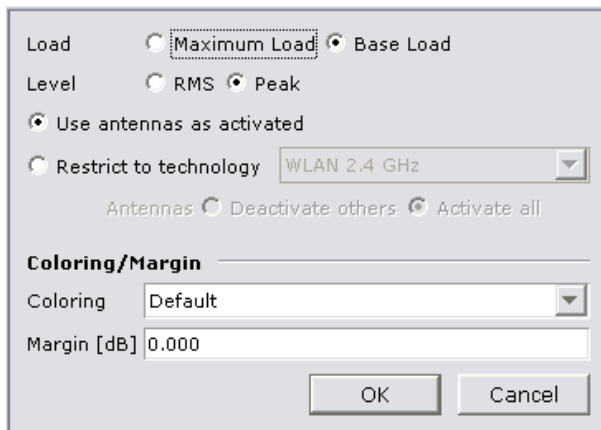


Figure 406: Creating field strength theme from calculation tab by right-clicking antennas

3. The field strength theme window opens:



Load ☐ Maximum Load ☒ Base Load

Level ☐ RMS ☒ Peak

☒ Use antennas as activated

☐ Restrict to technology WLAN 2.4 GHz

Antennas ☐ Deactivate others ☒ Activate all

Coloring/Margin

Coloring Default

Margin [dB] 0.000

OK Cancel

Figure 407: Field strength theme settings

4. Choose the **maximum load** or the **base load** to be used for the theme.
The maximum load is recommended to see results in extreme situations.
5. Choose **RMS** (root mean square) or **peak level** to be used.
Peak level is recommended to see results in extreme situations.
6. Choose to create the theme for **all activated antennas** or only a **specific technology**.
If the theme is restricted to a specific technology, choose whether the actual antenna or all antennas with that technology should be shown (only works with right-clicking on antennas in the Project-Explorer and choosing Field Strength Calculation or choosing antenna and click ).
7. Choose a **colour profile** and a **margin**.



To change colour profiles, see chapter 3.1.2.1.1.

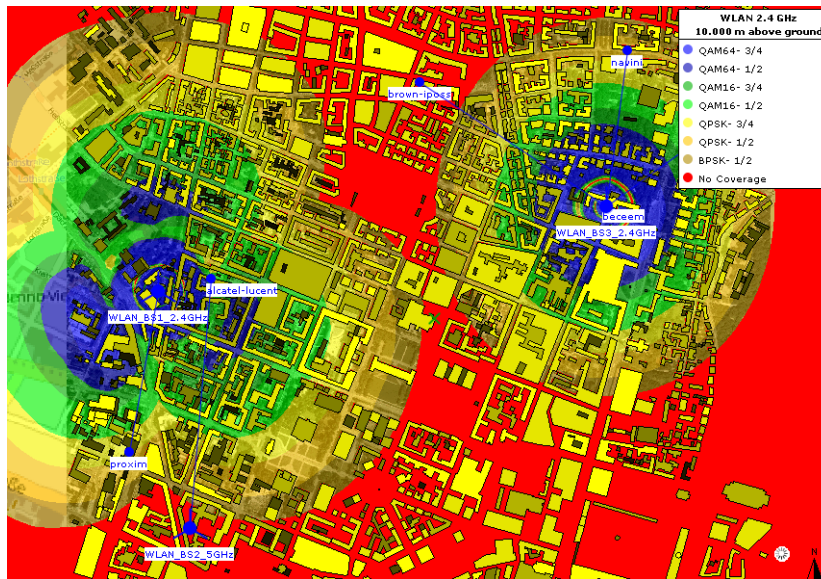


Figure 408: Munich: Field strength area calculation Erceg A

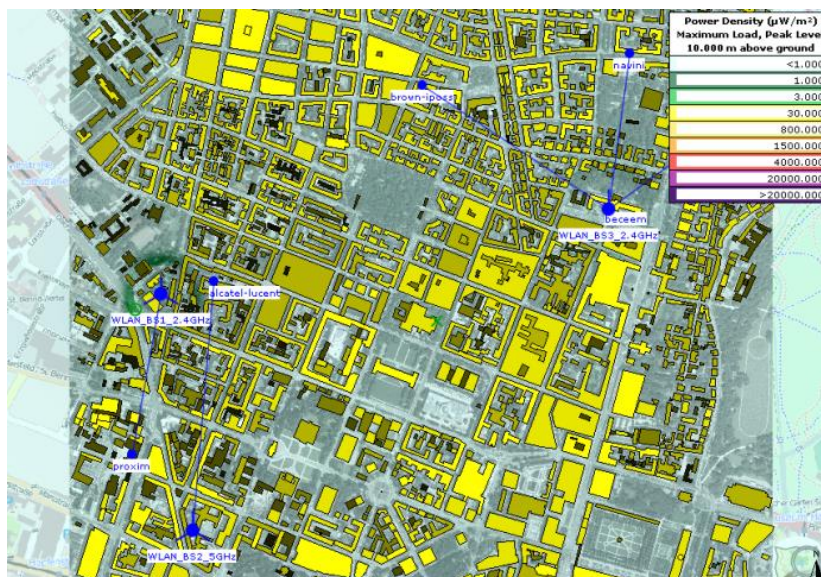


Figure 409: A field strength theme example: Munich, 0 dB margin, maximum load, peak level



Figure 410: A field strength theme example: Munich, 10 dB margin, maximum load, peak level

In our demo project Munich everything works fine and most of the area has a power density $< 1 \mu\text{W}/\text{m}^2$.

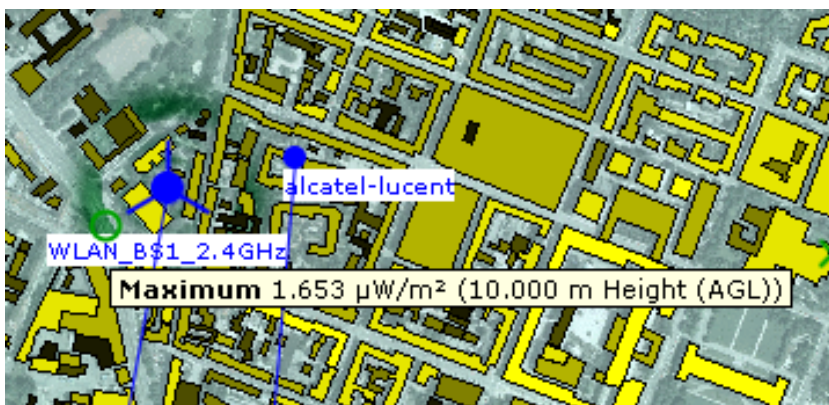


Figure 411: Marker for the best field strength

A little green circle on the map marks the area with the highest power density.
Drag the mouse cursor over that circle to show the exact power density.

10.12 The Elevation Theme

The **elevation theme** shows all the elevation differences in the terrain and therefore it is useful for presentations and for a better overview. It is also useful in the beginning of a project when the antennas and sites are placed. Environmental interferers like mountains are not visible without an elevation theme. The elevation theme can be used to create isolines for the desired terrain. These isolines can be exported into other programs for example Google Earth™ for a better presentation.



An elevation model is required for the elevation theme. For more information see chapter 4.2.



10.12.1 How to Create an Elevation Theme

1. *Import an elevation model.*
2. Choose **Themes**→**Elevation**→**Display**.

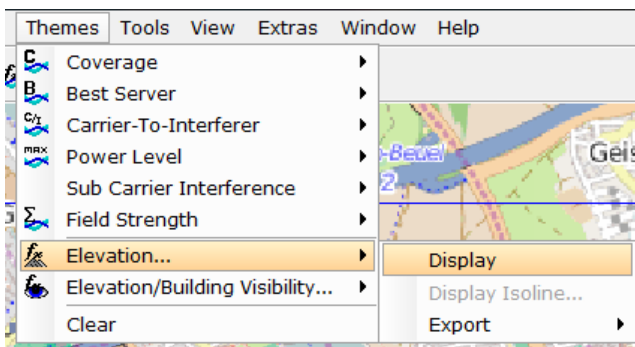


Figure 412: Creating an elevation theme from menu

3. The elevation theme window opens and some settings have to be done.

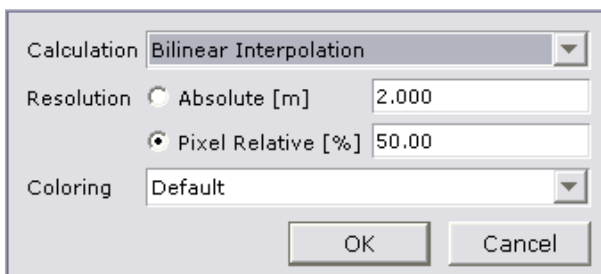


Figure 413: Elevation theme settings

Choose whether to use the **bilinear interpolation** or the **nearest neighbour** algorithm for the theme.



The bilinear interpolation is a much more precise algorithm and without special circumstances it should be used. The nearest neighbour algorithm is really imprecise but therefore the system requirements for this algorithm are very low.

The **resolution** can be chosen between **absolute** or **relative**.

Finally a **colour profile** needs to be set.



To change colour profiles, see chapter 3.1.2.1.1.

4. Press **OK** to create the theme.

In our example, the colour profile has been changed for a better overview.

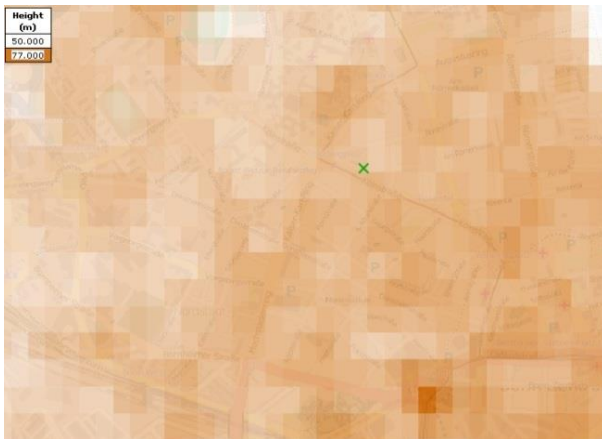


Figure 414: Elevation theme example, nearest neighbour, resolution relative 100 %



Figure 415: Elevation theme example, bilinear interpolation, resolution relative 100 %

10.13 The Visibility Theme

The **visibility theme** shows the visibility of a point in the users current view. With the help of this theme, the user can check the line of sight between two locations on the map. This can help to determine the exact coordinates for a site which should be planned. In addition,

the visibility theme will take account for both the elevation attenuation and buildings if there is no line of sight between the chosen points.



An elevation model is required to create a visibility theme. For more information see chapter 4.2.



10.13.1 How to Create a Visibility Theme

1. Import an elevation model.

Only this is required for a visibility theme.

2. Choose **Themes**→**Elevation/Building Visibility**→**Display**.

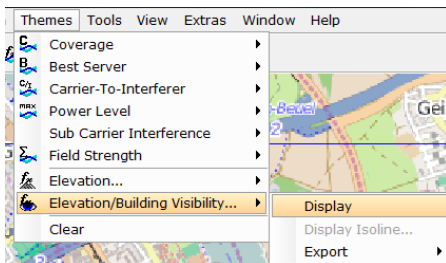


Figure 416: Creating a visibility theme

3. The visibility theme window opens and some settings have to be done.

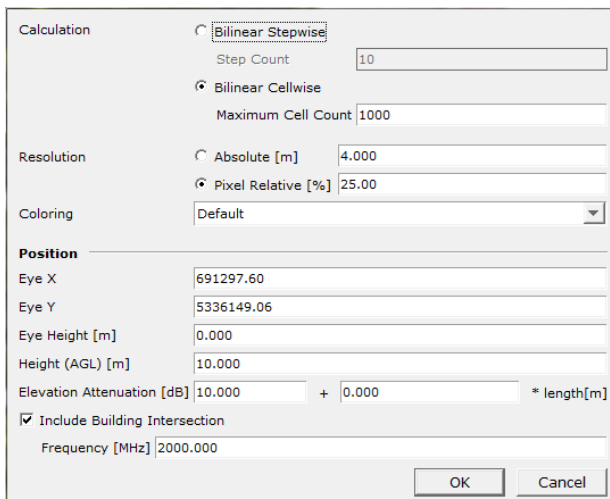


Figure 417: Visibility theme settings

Choose whether to use **bilinear cell-** or **stepwise** for the theme. Enter a value for the chosen technique and change the **resolution** to your needs. The **resolution** can be absolute or relative. At last, a **colour profile** needs to be set.



To change the colour profiles, see chapter 3.1.2.1.1.

4. Make some position settings to meet your special case.

- **EYE X:** The x-coordinate of the imaginary eye.
- **EYE Y:** The y-coordinate of the imaginary eye. These coordinates are set to the position of the cursor, by default.
- **Eye Height** specifies the height of the imaginary eye above the ground.
- **Height (AGL)** specifies the height above the ground onto which the imaginary eye looks.
- **Elevation Attenuation** specifies the attenuation that is considered in case of NLOS.
- **Include Building Intersection** considers visibility restrictions arising from the building model.
- In this case, a **frequency** needs to be specified for the special case.

5. Press **OK** to create the theme.

In our example, the colour profile has been changed for a better overview.



Figure 418: Visibility theme example, bilinear cellwise 1000, resolution relative 100 %



10.13.1.1 How to Clear the Visibility Cache

1. Choose **Themes** → **Clear**.

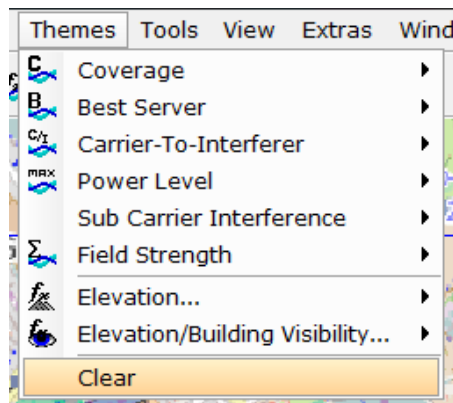


Figure 419: Clear the visibility layer



This will delete the whole theme from the project. Keep in mind that the theme cannot be returned and that this operation cannot be reverted. Time consuming calculations may have to be made again.



The more elegant way to hide themes is to deactivate the corresponding layers in the layer tab. For more information about layers, layer activation and deactivation, see chapter 2.4.2.

10.14 Export Calculation Theme

Export is an extension of the themes tab which does export the current visualization as presented in the GUI in one of the available formats (Image, ASCII, or KML). It is only available with a valid field strength calculation and visualization. Some formats (ASCII) are limited to Professional licensees.



Export requires a previous selected visualization theme and is restricted to the presented result. Please select the required theme accordingly before running the export.



10.14.1 How to Export a Theme

1. *Start a field strength area calculation and select a visualization theme.*
How to run a field strength calculation is described in 10.2. Available visualization themes and its selection are discussed in 10.6ff.
2. *Choose **Themes**→**Coverage (e.g.)**→**Export**.*

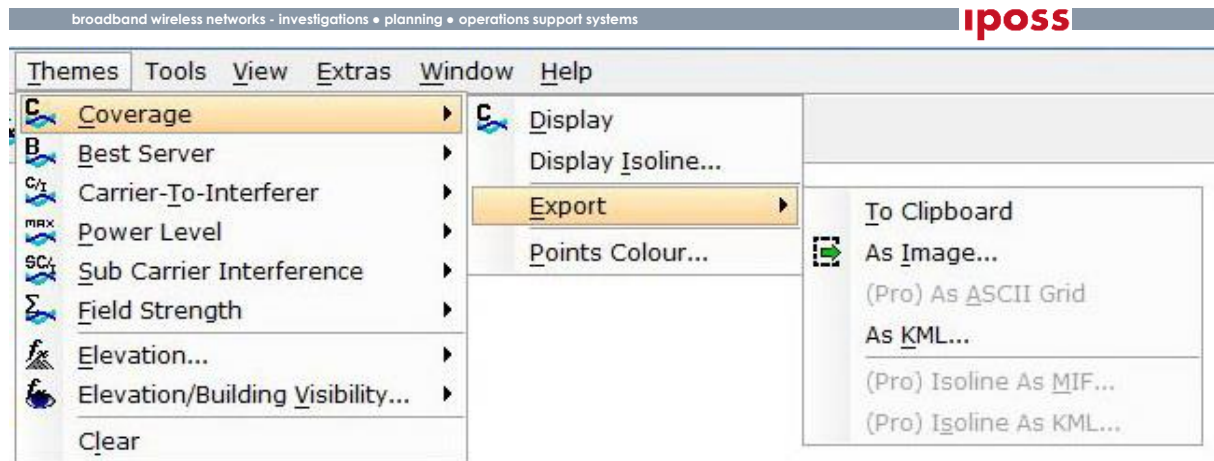


Figure 420: Submenu for elevation export

3. Choose the export format.

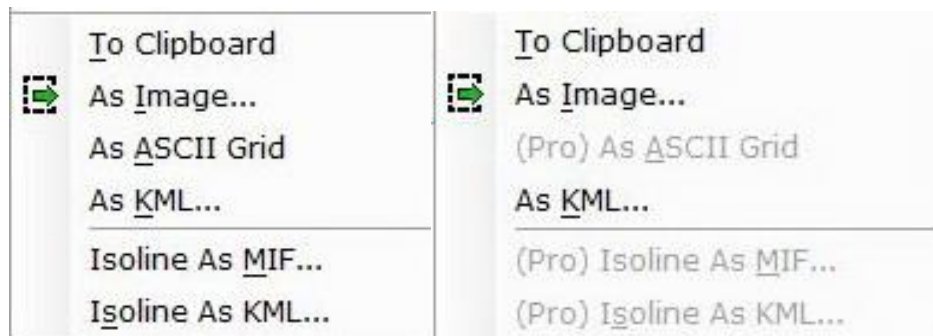


Figure 421: Available export (themes) formats (left: Professional-Edition | right: Community-Edition)

- **To Clipboard:**

The actual map will be copied in the system buffer like a screenshot and can be worked on **Paint**, for example.

- **As Image:**

The actual map will be saved in a .png or .jpg file.

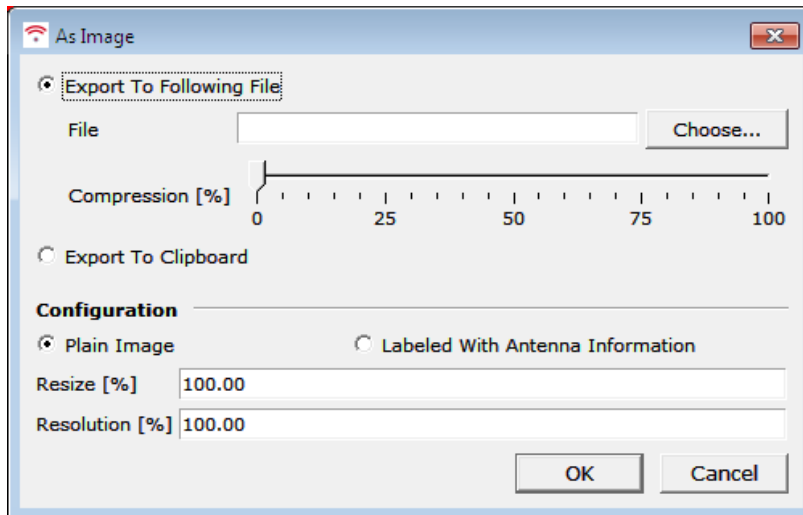


Figure 422: Export settings by export as image

- **As ASCII Grid: (not for Elevation)**

Export to ASCII requires a Professional license. The ASCII grid format can be imported by almost any GIS software.

- **As KML:**

The actual map will be saved in a .kml file. This file can be used in other programs like Google Earth™.

10.15 Clear and Delete Calculation

Clearing the calculation and theme cache is a fundamental thing that has to be done regularly to keep an overview on the project. There are a few possibilities to clear the calculation and theme cache or even to disable calculations or themes from time to time. An important fact to keep in mind: WiMAP-4G operates on different layers which can be activated or deactivated as desired.

Clearing the calculation and theme cache works for the following calculations:

- **coverage theme**
- **best server theme**
- **carrier-to-interferer theme**
- **power level theme**
- **sub-carrier interference theme**
- **field strength theme**
- **theme isolines**

- **elevation isolines**



The clear cache feature does not work for the field strength area calculation.



10.15.1 How to Clear the Calculation and Theme Layer

1. Choose **Themes**→**Clear**.

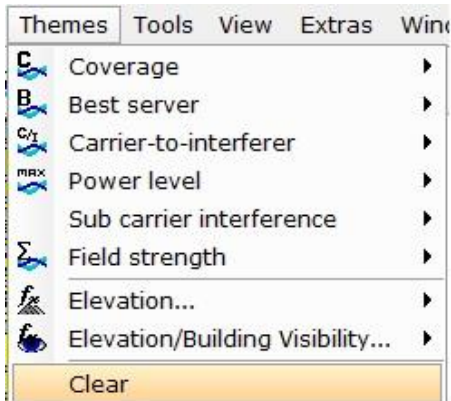


Figure 423: Clear the calculation layer



This will delete the whole calculation or theme from the project. Keep in mind that the calculations or themes cannot be returned and that this operation cannot be reverted. Time consuming calculations may have to be made again.



The more elegant way to hide themes is to deactivate the corresponding layers in the layer tab. For more information about layers, layer activation and deactivation see chapter 2.4.2.



10.15.2 How to Delete the Calculation

1. Take a right click on calculation data in the **Calculation tab** and click on **Delete Calculation**.

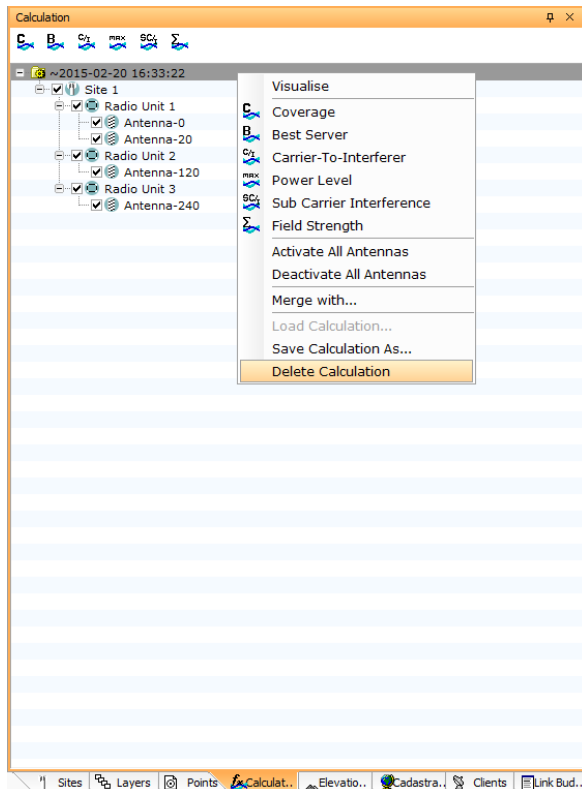


Figure 424: Delete calculation

2. The following delete calculation dialogue appears, if the calculation has not been saved before. It will get the same result like in 10.15.1

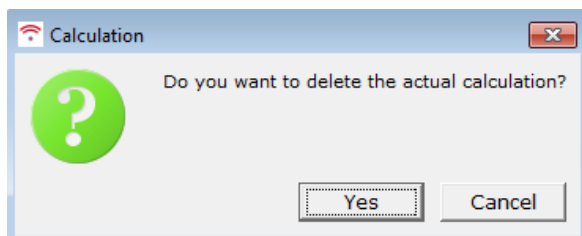


Figure 425: Deletion of the actual calculation

3. This dialogue appears, if the calculation has already been saved as a file.

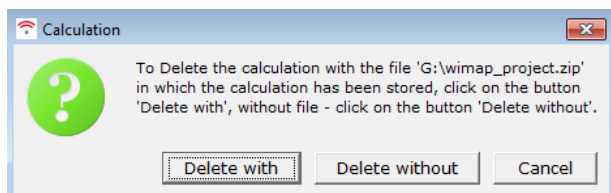


Figure 426: Delete calculation with/without file

4. Click on **Delete with**, if the file must be deleted.

10.16 Calculation with Desired/MIMO Antennas



10.16.1 How to Create a Power Level Theme with Desired/MIMO Antennas

1. Create MIMO antennas like in 7.1.10.1.
2. Open a carrier and select MIMO mode **Maximum Ratio Combining (MRC)**.

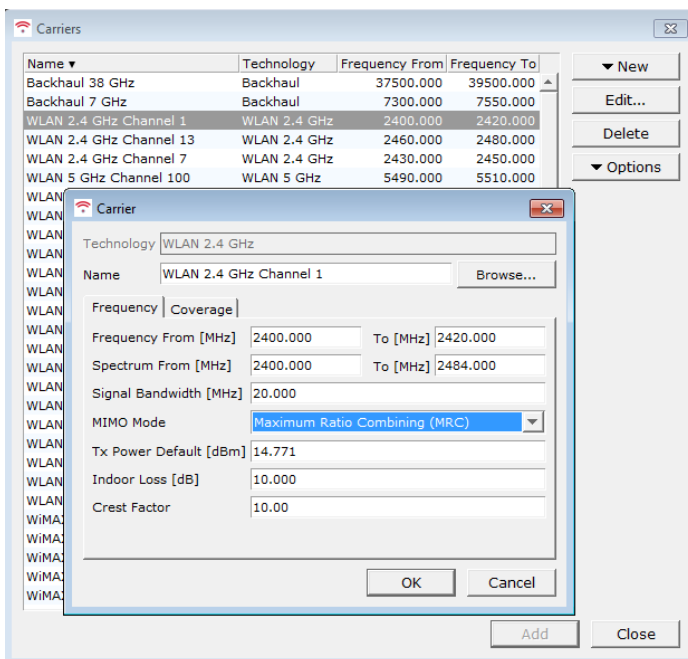


Figure 427: MIMO Mode Selection: Maximum Ratio Combining (MRC)

3. Make the Power Level Theme Calculation like in 10.9.

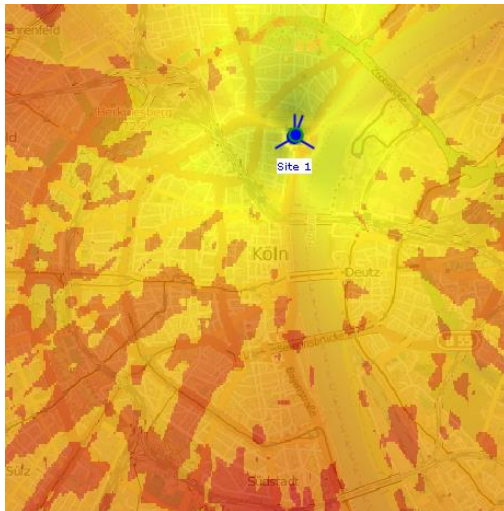


Figure 428: Calculation with Maximum Selection Combining (MSC)

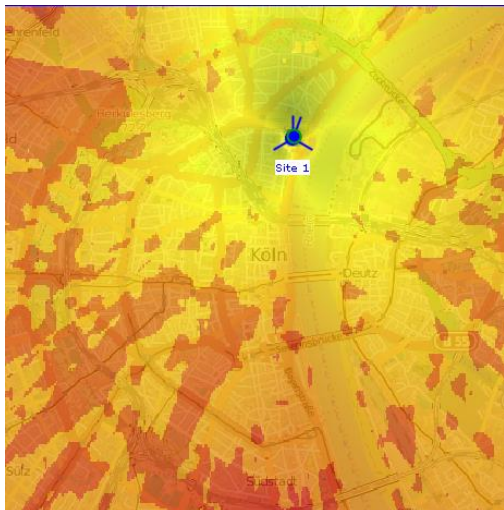


Figure 429: Calculation with Maximum Ratio Combining (MRC)

11 Isolines

Isolines connect points of equal value on the map. The prefix iso means equal. Isolines can be used for presentation and to keep track on a project. They can be exported and imported to other programs, for example, Google Earth™.

There are two different types of isolines in WiMAP-4G:

- **theme isolines**
- **elevation isolines**

11.1 Theme Isolines

Theme isolines are used to show the coverage of an area. They are geared to the coverage theme or the field strength area calculation. Therefore it is necessary to make a field strength area calculation before creating theme isolines.



11.1.1 How to Create Theme Isolines

1. *Make a field strength area calculation and create a theme.*
(A more precise calculation offers better overview but takes more time to calculate.)



To make a field strength area calculation see chapter 10.2.1.

2. Choose **Themes** → **kind of themes** → **Display Isoline...**

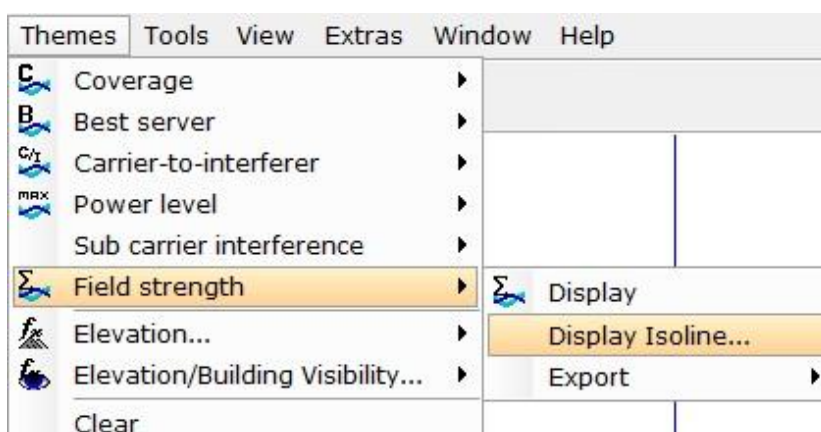


Figure 430: Create isolines

3. The theme isolines window opens and some configuration have to be made.

Just check the states which should be marked with isolines, change the colour and press **OK** to start the calculation. Checking **Remove existing isolines** deletes former isolines from the project while calculating new isolines.

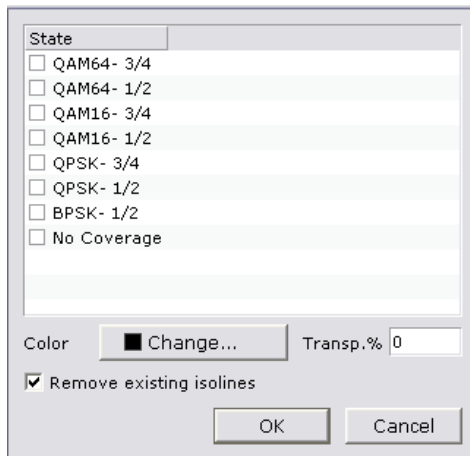


Figure 431: Choose the states for the isolines

It should be clear that all checked states will be included in the mark on the map. So if all states are activated, only a square will be marked because all the states are included. It is recommended to make isolines for the desired states separately and in different colours for a better overview. In our example, the colours have been taken from the coverage colour profile.

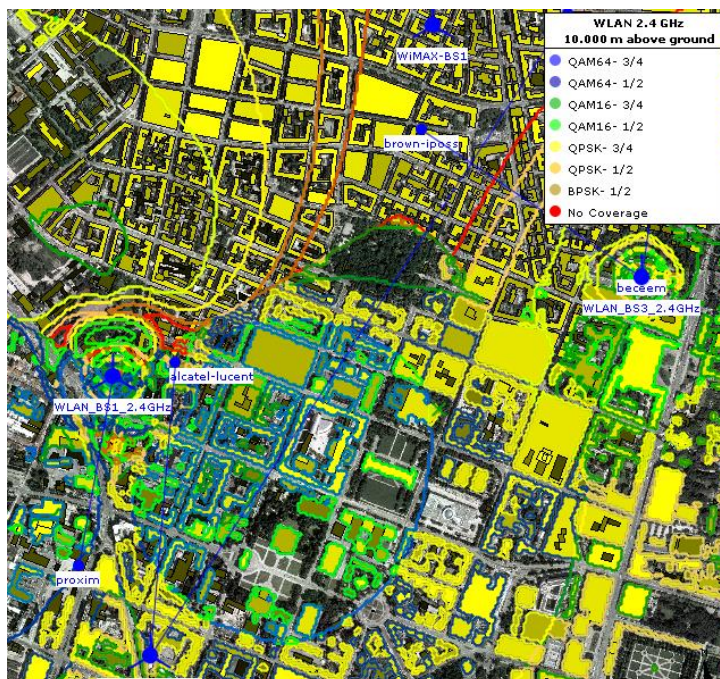


Figure 432: Theme isolines example, Munich, coverage

Buildings make the isoline calculation more detailed but the overview can get lost fast, because there are so many labels around buildings. Keep in mind that the elevation labels can be deactivated in the layers tab of the Project-Explorer.

11.2 Elevation Isolines

The elevation isolines can be used to mark different heights in the environment. They can be exported and guide themselves on the elevation model. An elevation model is required to create elevation isolines.



11.2.1 How to Create Elevation Isolines

1. *Import an elevation model.*



To import an elevation model, see chapter 4.2.1.

2. *Create an elevation theme.*



To make an elevation calculation, see chapter 10.12.1.

3. Choose **Themes**→**Elevation**→**Display Isoline...**

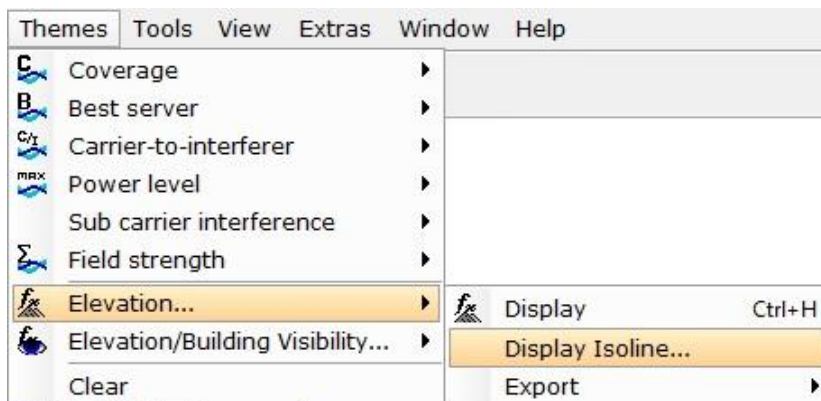


Figure 433: Create elevation isolines

4. The elevation isolines window opens and some adjustments have to be done.

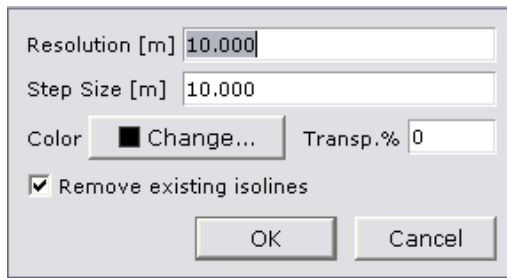


Figure 434: Fill in the desired values

Choose the **resolution** (a more precise resolution takes more time to calculate but offers better results) and the **colour** and **transparency** for the isolines.

The step size describes the difference between two isolines on the same environment in m. If there is a height difference of 8 m all around the environment, only one isoline will be shown while using the default 10 m. With a step size of 2 m, four different isolines will pop up for the same environment, each of them for a different height level.

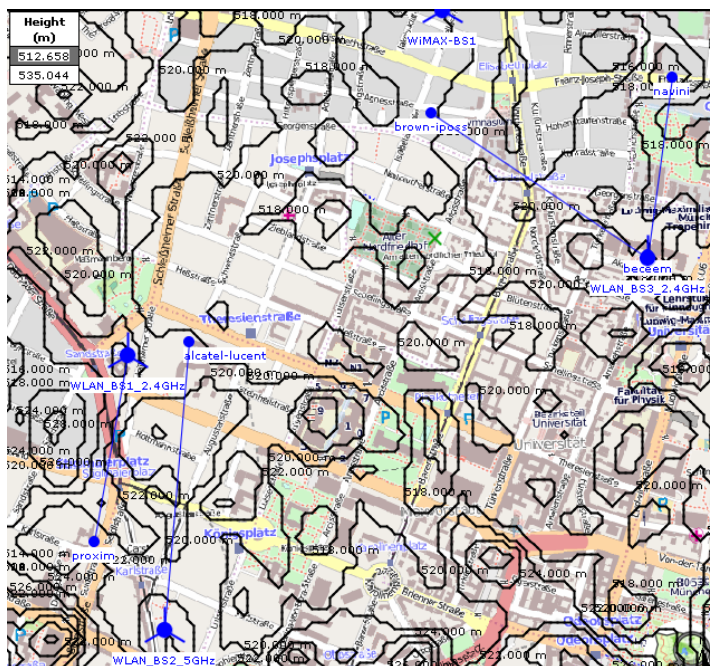


Figure 435: Elevation isolines example, Munich

11.3 Isoline Export

Sometimes it could be necessary to export created isolines for theme or elevation.

Exporting isolines is possible with WiMAP-4G. It is especially helpful exporting these isolines to other programs, for example to show them in presentations or joining programs that work with isolines, like Google Earth™.



11.3.1 How to Export Isolines as MIF

Assuming that isolines have been created. Otherwise the export may be possible but it would not offer any usable data.

1. Choose **Themes**→***kind of theme***→**Export**→**Isoline as MIF**.

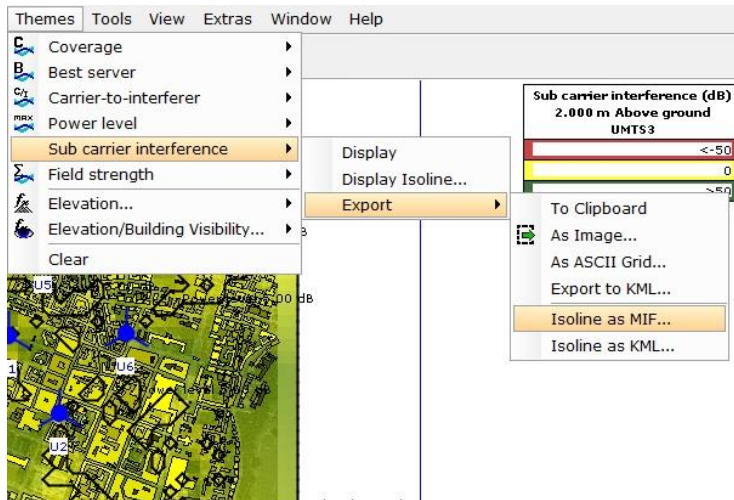


Figure 436: Export isolines as .mif

2. Choose a **filepath** and a **filename** and press **OK** to save the file.

There is no need to do any settings. All displayed isolines will be exported. All theme isolines will be exported to the .mif format and can be used in other programs that can handle the .mif format.



11.3.2 How to Export Isolines as KML

Assuming that isolines have been created. Otherwise the export may be possible but it would not offer any usable data.

1. Choose **Themes**→***kind of theme***→**Export**→**Isoline as MIF**.

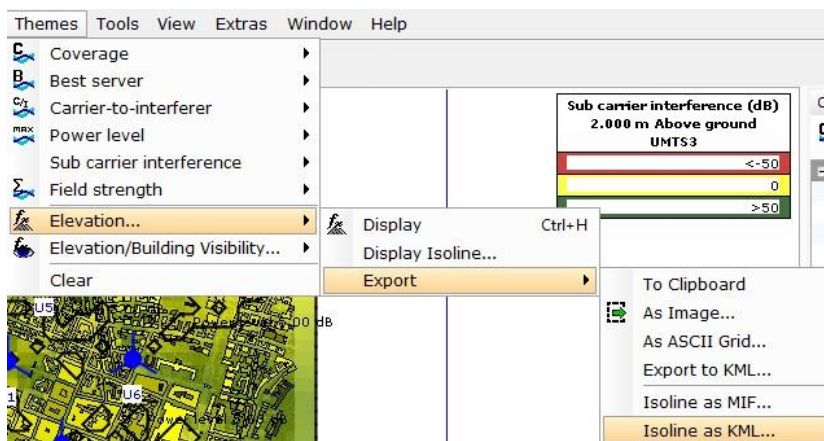


Figure 437: Export isolines as .kml

2. Choose a **filepath**, **filename** and press **OK** to save the file.

There is no need to do any settings. All displayed isolines will be exported. All theme isolines will be exported to the .kml format and can be used in other programs that support the .kml format.



Unlike the .mif format, the .kml format can be used with many programs. The most common is Google Earth™ which can import and display .kml isolines.

12 Additional Functions

12.1 Show on Google Maps™

Google Maps™ is a map service of Google™. With the option **Show on Google Maps...** a chosen point can be shown on Google Maps™.



12.1.1 How to Use the function **Show on Google Maps**

1. Take a right-click on a point of the map and select the option **Show on Google Maps...**

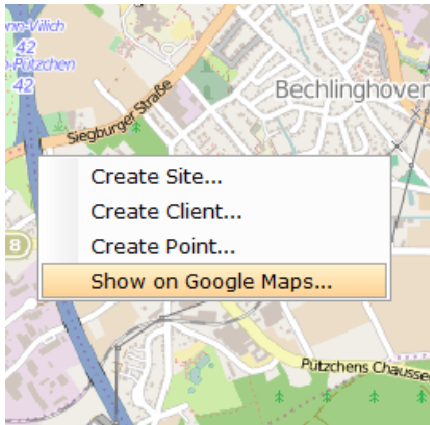


Figure 438: Show on Google Maps

2. An internet browser will be opened and load the website of Google Maps™. After this the selected point of the WiMAP-4G project is the center of the map of Google Maps™.

12.2 Activation/Deactivation

Many objects in WiMAP-4G can be activated/deactivated on GUI. There are various methods to do it. How to activate/deactivate Sites/Radio Units/Antennas/Points/Clients can be read in the previous chapters.



12.2.1 How to Activate und Deactivate Layers

1. Open the **Layers Tab** in the **Project-Explorer**.
2. Right-click any entry on the **Layers Tab** and click on **Filter-Activation...**

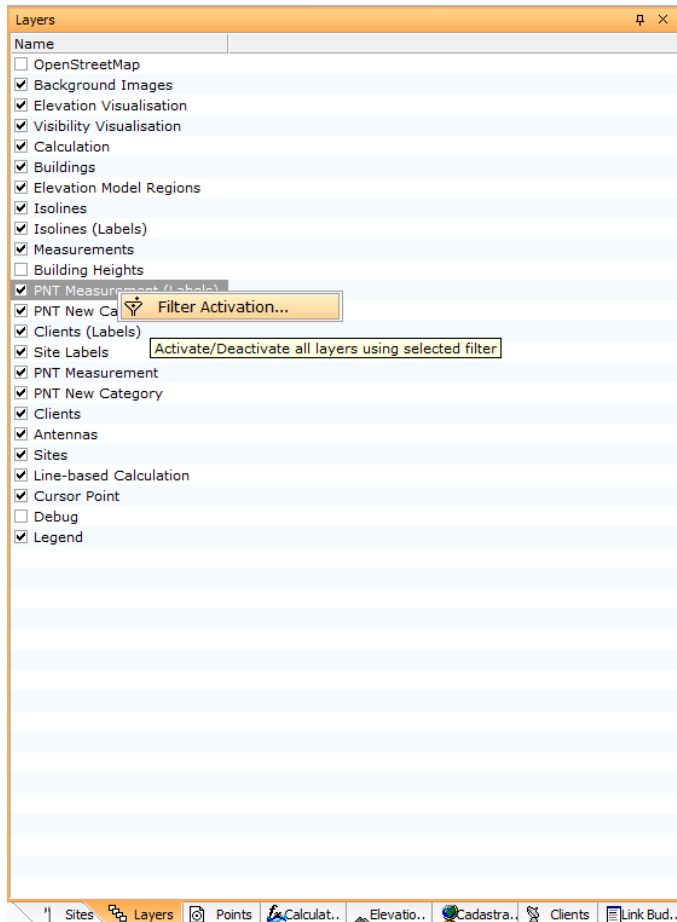


Figure 439: Right-click on Layers Tab

3. Choose **Activate** to activate the desired layers or the other way around. Enter the layers at the **Start With** field which should be activated/deactivated and click **OK**.

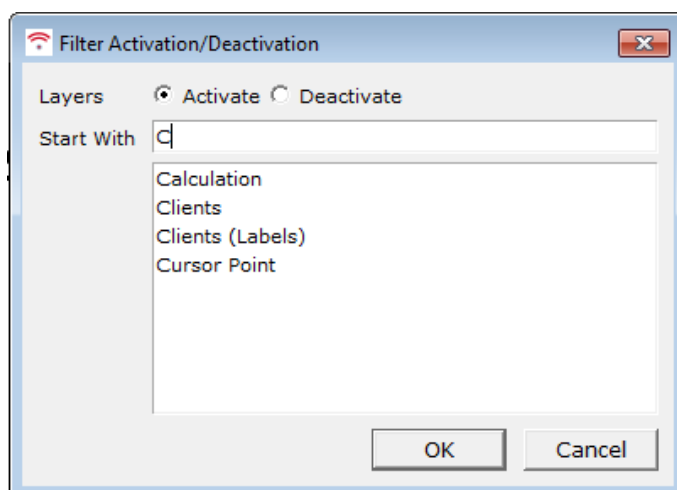


Figure 440: Filter Activation dialogue window

12.3 Colour

Sites, antennas and points can be coloured for a better overview. Changing the colour of a site leads to a colour change of all radio units and antennas of the selected site.



12.3.1 How to Make a Site coloured

1. *Open the setting of a site or create a new site.*

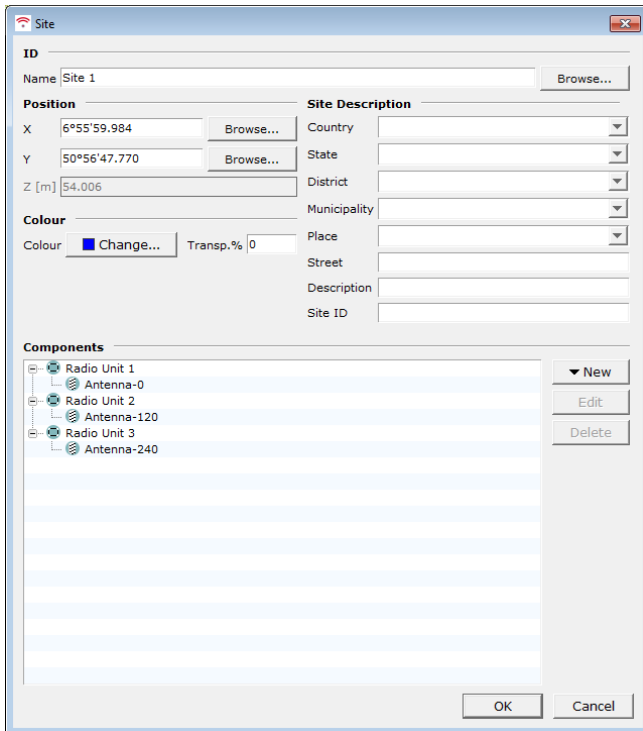


Figure 441: Settings of a site

2. *Under the heading **Colour** the colour and the transparency can be changed (in %). Click on **Change** to change the colour.*

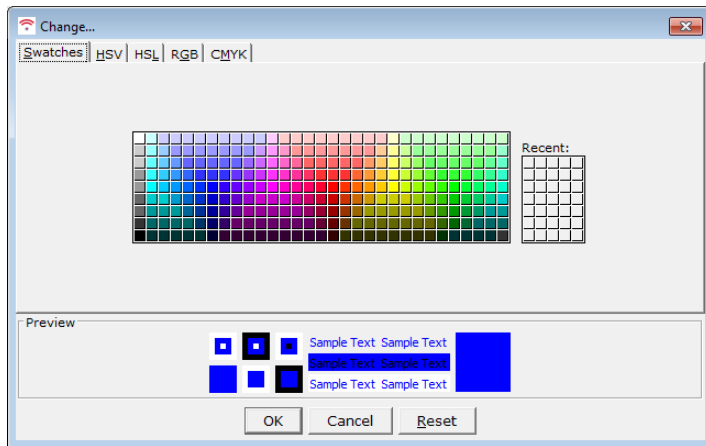


Figure 442: Select the colour

3. Select your new colour, click on **OK**. On site settings click again on **OK**. Now your selected site is in the desired colour.



The colour of clients change to the colour of the site automatically.
The colour of radio units and antennas of a site change their colour to the site colour.



12.3.2 How to Make a Radio Unit coloured

The colour change of a radio unit is the result of a colour change by all antennas of the selected radio unit.

1. Open radio unit settings.

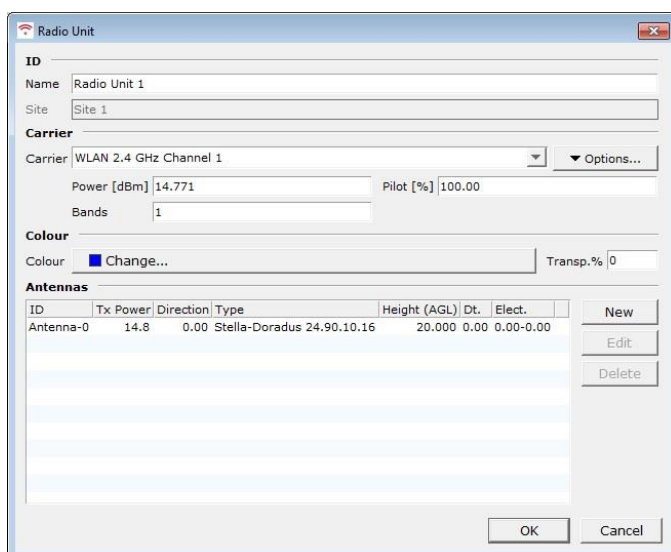


Figure 443: Radio unit settings

2. Click on **Change** on the colour field.

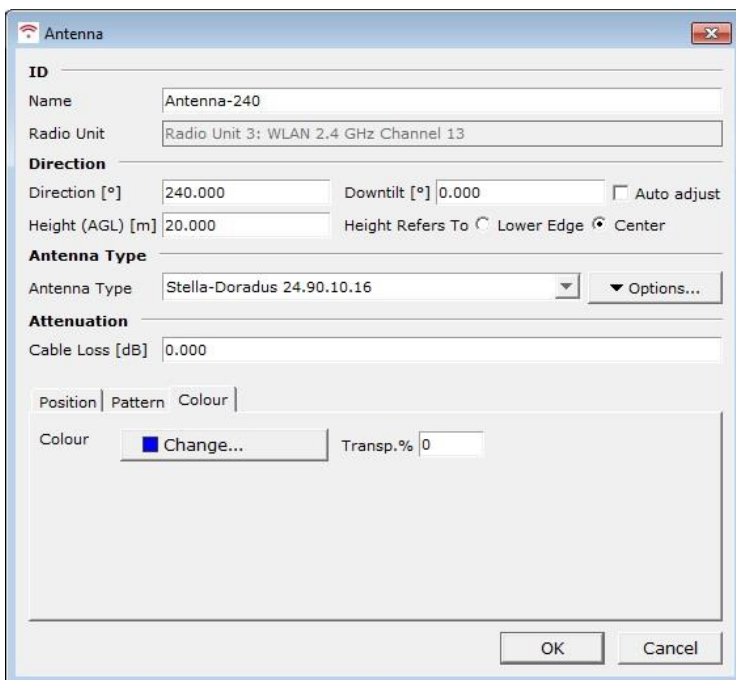
3. Choose the new colour and click on **OK**. To save new colour click on **OK** in the radio unit settings.



12.3.3 How to Make an Antenna coloured

The colour of antennas can be set on the sites colour, radio unit colour and antennas. If the colour of the upper elements is changed, the antenna colour will be changed, too.

1. Open antenna settings.



The image shows the 'Antenna' settings dialog box. It has several sections: 'ID' with 'Name' (Antenna-240) and 'Radio Unit' (Radio Unit 3: WLAN 2.4 GHz Channel 13); 'Direction' with 'Direction [°]' (240.000), 'Downtilt [°]' (0.000), and 'Auto adjust' checkbox; 'Height (AGL) [m]' (20.000) and 'Height Refers To' (Lower Edge, Center); 'Antenna Type' (Stella-Doradus 24.90.10.16) with an 'Options...' button; 'Attenuation' with 'Cable Loss [dB]' (0.000); and a 'Colour' section with 'Position', 'Pattern', and 'Colour' tabs. The 'Colour' tab is active, showing a 'Change...' button and a 'Transp.%' field (0). 'OK' and 'Cancel' buttons are at the bottom.

Figure 444: Antenna settings

2. Under the Option **Colour** the colour and the transparency (in %) can be changed. Click on **Change** to change the colour.
3. Select your new colour and click on **OK** to close setting panel. Now your selected antenna is displayed on the Terrain-Explorer with new colour.



To change multiple antennas look at chapter 7.1.4. For changing the colour of radio units look at chapter 7.2.5.



12.3.4 How to Make a Point coloured

Look at chapter 8.6.

13 Link Budget

The link budget is the account of all the losses and gains during a transmission inside the medium, antennas, cable etc. The way to calculate the link budget basically is:

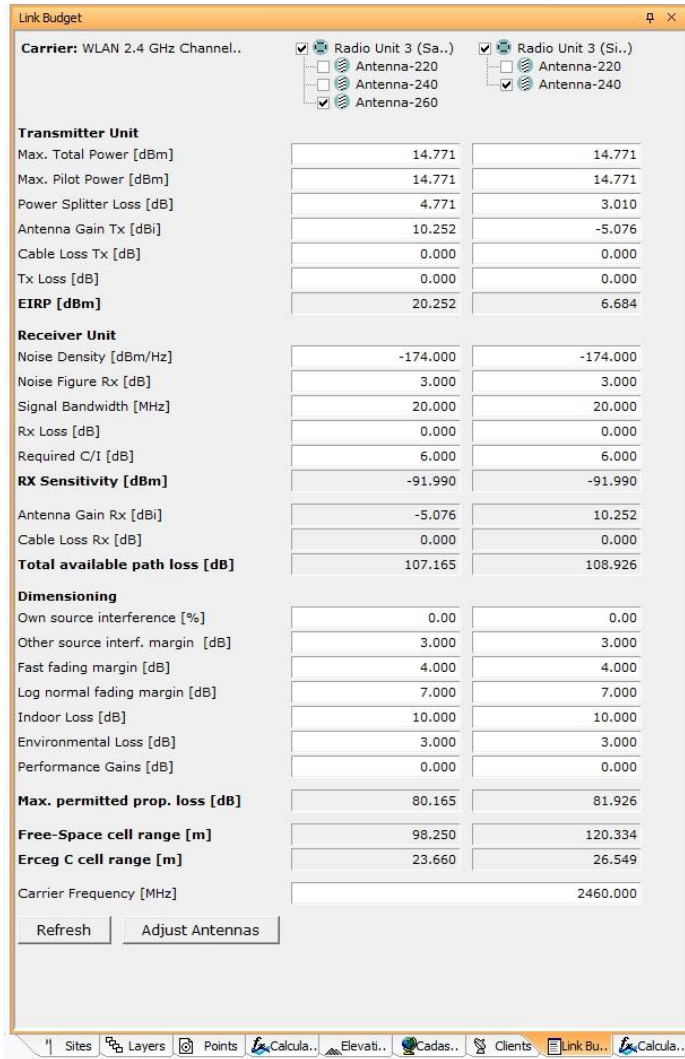
Received Power = Transmitted Power + Gains – Losses

WiMAP-4G offers many parameters for the link budget calculation and therefore the most precise result is guaranteed.

The following parameters can be adjusted:

- **Max. Total Power:** Maximum power of the base station
- **Max. Pilot Power:** Maximum pilot power of the base station
- **Power Splitter Loss:** Loss of splitter
- **Antenna Gain Tx:** Antenna gain for the specific transmission (vertical and horizontal tilt involved)
- **Cable Loss Tx:** The used cables loss
- **Tx Loss:** The power which could get lost between two transmission points
- **EIRP:** Equivalent isotropically radiated power (the result)
- **Noise Density:** Noise power per unit of bandwidth
- **Noise Figure Rx:** Difference between the output of the receiver and the output of an ideal receiver with same gain
- **Signal Bandwidth:** Signal bandwidth from the carrier
- **Rx Loss:** Receive loss between the stations
- **Required C/I:** The minimum desired C/I
- **Rx Sensitivity:** The minimum signal power that is needed to create the required SNR (the result)
- **Antenna Gain Rx:** Antenna gain TX of the corresponding station
- **Cable Loss Rx:** Cable loss of the corresponding station
- **Total available path loss:** Maximum path loss between stations
- **Own source interference:** Interference from the sending antenna itself
- **Own source interference margin:** Interference margin from the sending antenna itself
- **Fast fading margin:** Margin required to compensate fades
- **Log normal fading margin:** Margin to guarantee coverage probability
- **Indoor Loss:** Loss caused by walls or vehicles
- **Environmental Loss:** Loss caused by the environment

- **Performance Gains:** Performance gains added with special antennas or configurations
- **Max. permitted propagation loss:** Result of total available path loss and dimensioning parameters
- **Free Space cell range:** Maximum cell range using Free Space Propagation
- **Erceg C cell range:** Maximum cell range using Erceg propagation model
- **Carrier Frequency:** Frequency used by the antennas (2.4 GHz, 5.4 GHz, ...)



Carrier: WLAN 2.4 GHz Channel..	Radio Unit 3 (Sa..)	Radio Unit 3 (Si..)
	Antenna-220	Antenna-220
	Antenna-240	Antenna-240
	Antenna-260	
Transmitter Unit		
Max. Total Power [dBm]	14.771	14.771
Max. Pilot Power [dBm]	14.771	14.771
Power Splitter Loss [dB]	4.771	3.010
Antenna Gain Tx [dBi]	10.252	-5.076
Cable Loss Tx [dB]	0.000	0.000
Tx Loss [dB]	0.000	0.000
EIRP [dBm]	20.252	6.684
Receiver Unit		
Noise Density [dBm/Hz]	-174.000	-174.000
Noise Figure Rx [dB]	3.000	3.000
Signal Bandwidth [MHz]	20.000	20.000
Rx Loss [dB]	0.000	0.000
Required C/I [dB]	6.000	6.000
RX Sensitivity [dBm]	-91.990	-91.990
Antenna Gain Rx [dBi]	-5.076	10.252
Cable Loss Rx [dB]	0.000	0.000
Total available path loss [dB]	107.165	108.926
Dimensioning		
Own source interference [%]	0.00	0.00
Other source interf. margin [dB]	3.000	3.000
Fast fading margin [dB]	4.000	4.000
Log normal fading margin [dB]	7.000	7.000
Indoor Loss [dB]	10.000	10.000
Environmental Loss [dB]	3.000	3.000
Performance Gains [dB]	0.000	0.000
Max. permitted prop. loss [dB]	80.165	81.926
Free-Space cell range [m]	98.250	120.334
Erceg C cell range [m]	23.660	26.549
Carrier Frequency [MHz]	2460.000	
Refresh Adjust Antennas		

Figure 445: The Link Budget tab



13.1 How to Make a Link Budget Calculation

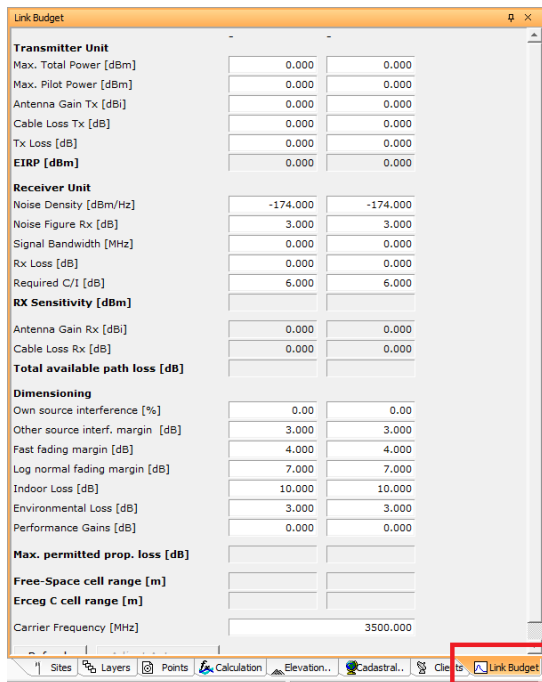
Basically there are two different methods to make a link budget calculation: Use the Terrain-Profiler to make a calculation or calculate manually. The manual way is useful to make calculations that cannot be done with the Terrain-Profiler or ad-hoc calculations without having planned any sites, antennas, etc.

13.1.1 Manually

1. Open the **Link Budget** calculation tab in the Project-Explorer or choose **Link→Link Budget**.
2. Enter the corresponding values into the link budget tab.

Existing values are set by default while starting the link budget calculation to match the standard values for the corresponding parameter. Do not change these parameters if you are not sure what they do or which more specific values could match your special case.

3. WiMAP-4G automatically changes the results while you insert the values.



Transmitter Unit	
Max. Total Power [dBm]	0.000
Max. Pilot Power [dBm]	0.000
Antenna Gain Tx [dBi]	0.000
Cable Loss Tx [dB]	0.000
Tx Loss [dB]	0.000
ETRP [dBm]	0.000
Receiver Unit	
Noise Density [dBm/Hz]	-174.000
Noise Figure Rx [dB]	3.000
Signal Bandwidth [MHz]	0.000
Rx Loss [dB]	0.000
Required C/I [dB]	6.000
RX Sensitivity [dBm]	
Antenna Gain Rx [dBi]	0.000
Cable Loss Rx [dB]	0.000
Total available path loss [dB]	
Dimensioning	
Own source interference [%]	0.00
Other source interf. margin [dB]	3.000
Fast fading margin [dB]	4.000
Log normal fading margin [dB]	7.000
Indoor Loss [dB]	10.000
Environmental Loss [dB]	3.000
Performance Gains [dB]	0.000
Max. permitted prop. loss [dB]	
Free-Space cell range [m]	
Erceg C cell range [m]	
Carrier Frequency [MHz]	3500.000

Figure 446: The Link Budget tab

13.1.2 Automatically by Using the Terrain-Profiler

To calculate the link budget automatically, two sites need to be created.

1. Choose the **Terrain-Profiler** on tool panel, click on the first station and drag the mouse cursor to the desired second station. Click the mouse button to open the snap window. The easiest way to calculate the link budget of two stations is to drag the Terrain-Profiler from one object to another and to pick both objects in the snap window.



Figure 447: Select objects with Terrain-Profiler

2. Now choose between **coordinate** or **object** options and select similar snap objects. If snap objects are incompatible, the link budget calculation is impossible. In this case WiMAP-4G logs out with the error message **"The selected carrier does not match."**

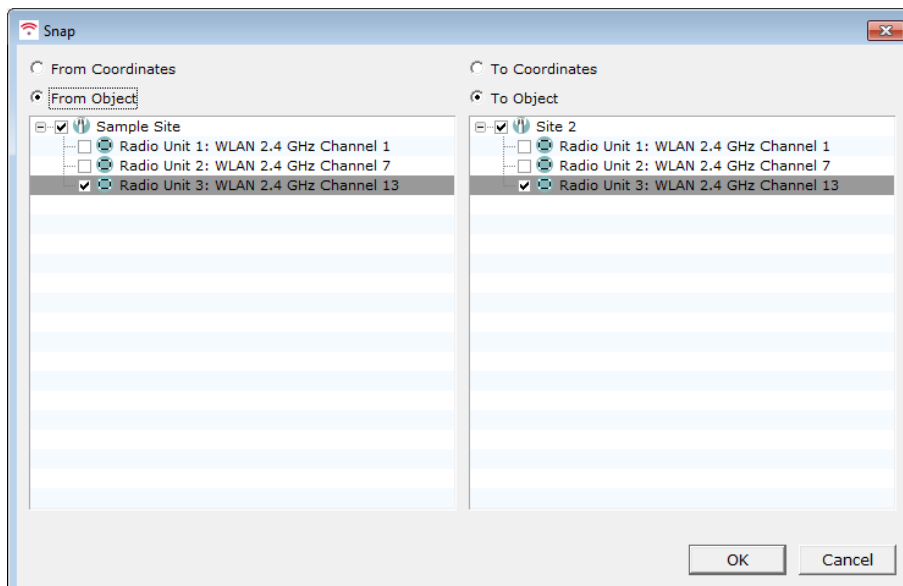
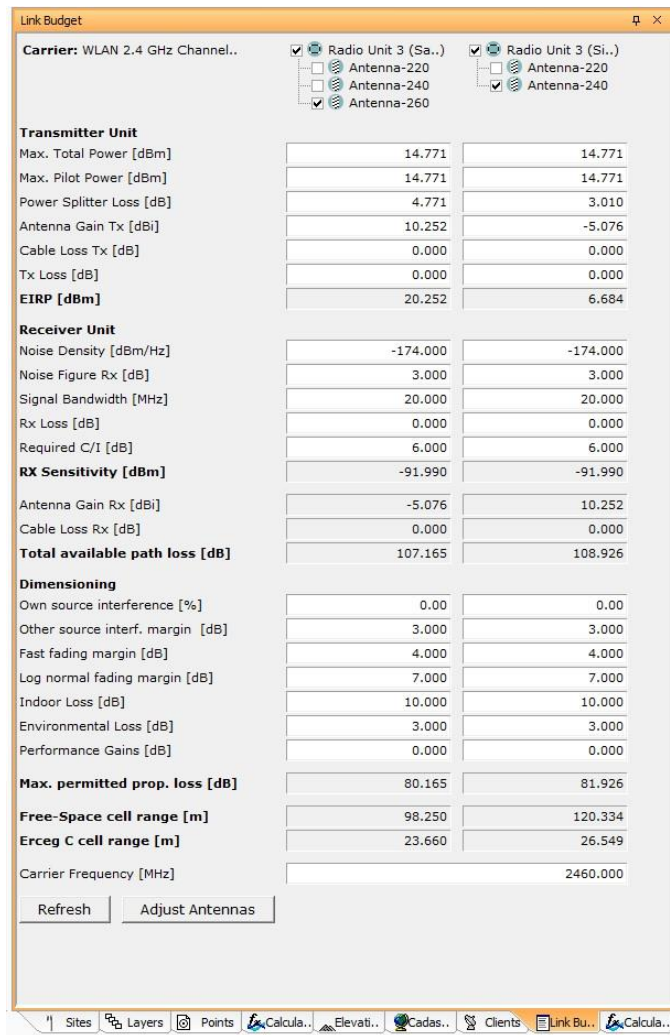


Figure 448: The snap window appears after connecting two points

3. After choosing **objects** or **coordinates**, click on **OK** to start the link budget calculation.

The values for the two objects are inserted automatically - the calculation is done. Manual adjustments are possible only for the default values and the dimensioning parameters. All values that have been gathered from the stations cannot be edited. The antennas of a radio unit can be chosen but you can select only one antenna per radio unit for calculation. If the antenna selection is changing, the parameters of **Terrain-Profiler** and Link Budget refresh themselves automatically.



Link Budget

Carrier: WLAN 2.4 GHz Channel..

Radio Unit 3 (Sa..) ☒ Antenna-220 ☐ Antenna-240 ☒ Antenna-260

Radio Unit 3 (Si..) ☒ Antenna-220 ☐ Antenna-240 ☒ Antenna-260

Transmitter Unit	
Max. Total Power [dBm]	14.771
Max. Pilot Power [dBm]	14.771
Power Splitter Loss [dB]	4.771
Antenna Gain Tx [dBi]	10.252
Cable Loss Tx [dB]	0.000
Tx Loss [dB]	0.000
EIRP [dBm]	20.252

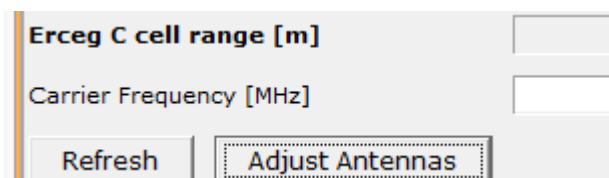
Receiver Unit	
Noise Density [dBm/Hz]	-174.000
Noise Figure Rx [dB]	3.000
Signal Bandwidth [MHz]	20.000
Rx Loss [dB]	0.000
Required C/I [dB]	6.000
RX Sensitivity [dBm]	-91.990
Antenna Gain Rx [dBi]	-5.076
Cable Loss Rx [dB]	0.000
Total available path loss [dB]	107.165

Dimensioning	
Own source interference [%]	0.00
Other source interf. margin [dB]	3.000
Fast fading margin [dB]	4.000
Log normal fading margin [dB]	7.000
Indoor Loss [dB]	10.000
Environmental Loss [dB]	3.000
Performance Gains [dB]	0.000
Max. permitted prop. loss [dB]	80.165
Free-Space cell range [m]	98.250
Erceg C cell range [m]	23.660
Carrier Frequency [MHz]	2460.000

Refresh Adjust Antennas

Figure 449: Link Budget calculation

- Find the button **Adjust Antennas** in the lower left corner of the link calculation tab. Click on this button and the selected antennas of the radio unit will be adjusted automatically by WiMAP-4G to guarantee the best results for the link budget calculation and also for common. It is not recommended to adjust the antennas if they have already been planned for a specific scenario. With these adjustments the link budget seems to look better but hence problems can occur. If an adjustment is made for the antennas or the stations, click on the **Refresh** button in the lower left corner of the link budget to assign these new values to the link budget calculation.



Erceg C cell range [m]

Carrier Frequency [MHz]

Refresh Adjust Antennas

Figure 450: Adjust antennas

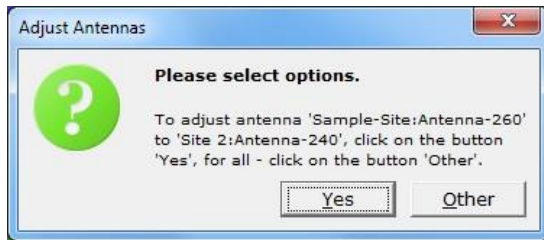


Figure 451: Adjust antennas – select options

14 3D View

With the 3-dimensional view, impressing presentations can be done for various projects. A 3D environment will be rendered for the actual project, showing all objects that have been placed and all calculations that have been done in the project. This is useful to get a good overview about the real look. It is also possible to determine potential problems with the 3D-view.



14.1 How to Create a 3D View

1. Choose **View**→ **Create 3D View**.

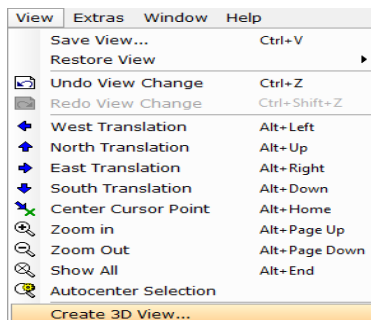


Figure 452: Create a 3D view

The 3D view window opens and the actual project will be shown in 3D. Every calculation can be shown in a 3D model, so feel free to make a few calculations before creating a 3D view. This will give you a much better view. Problems can be also determined much better with the corresponding calculation, shown in the 3D view.

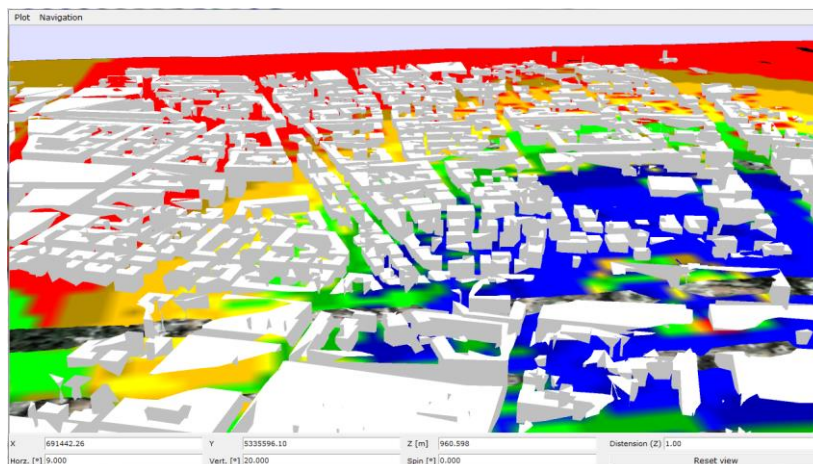


Figure 453: Example of a 3D view

As shown in Figure 453, all buildings are created in the 3D view. A coverage calculation with the typical parameters and colours can be seen here.

14.2 Navigate the 3D-View

Navigation inside the 3D-view is quite simple. Holding down the right mouse button enables the "look"-function. Simply slide the mouse to change the camera view. Holding down the left mouse button enables the "move"-function. Slide the mouse to move around the map. With these two functions, nearly every move can be done on the map. On the bottom at the window the values for the 3D-view can be changed. These seven values allow to view everything on the map from every angle and distance. If you have changed one of the values *click with the left mouse button in the 3D-view*.

X and **Y** describe the actual coordinates of the camera.

Horizontal and **vertical** describe the angle of the camera. Experimenting a little with these values make it quite clear how to use them.

Z, **spin** and **distension** are interesting labels. They can make it much easier to locate and show specific objects. These labels are for experienced user. Keep in mind that they can also cause the whole view to vanish from the screen if useless values were inserted.

X	689337.77	Y	5334260.62	Z [m]	960.598	Distension (Z)	1.00
Horz. [°]	45.000	Vert. [°]	22.500	Spin [°]	0.000	Reset view	

Figure 454: Values for 3D-View

Distension is the axial extension of the Z-axis. Therefore a higher value stretches the buildings and makes them higher for the human eye. This is useful if the project only holds buildings with small heights. The distension will stretch them a little bit and gives them better visibility. The maximum value of distension is 10, which means a building will be shown 10 times higher than in reality.

Spin just spins the view a little bit to the desired angle. Playing with that value shows effects quite clear.

The **Z** label is the most interesting because it allows the user to zoom in and out. This function could sometimes be required to show specific objects or discover problems that might be hidden in detail.

The first thing to understand is that a 3D view cannot exist with only a X- and Y-axis. A third axis is required to add a steric component. This required axis is the Z-axis. Playing a little bit with this value should show the effect.

Keep in mind that a value smaller than the average area height used in the project will make the project disappear in the 3D view.

Always use a value higher than the highest point in your project.

An elevation calculation may help to determine the height of that highest point.

14.2.1 Navigation Specials

Integrated into the 3D-View window, there is a menu named **Navigation** which offers a few possibilities to navigate through a 3-dimensional environment:

- **Camera Platform:** The standard view which allows the user to navigate with the mouse buttons and the labels at the bottom of the window.
- **Autopilot:** Starts a camera flight over the environment - a good application for presentations.
- **Center Antenna:** Opening the 3D view is sometimes quite confusing. Antennas cannot be found really fast because they are hidden between the buildings. A field strength area calculation maybe helps to locate the antennas a little bit better, but it is not the optimal solution for presentations. The Center Antennas Option opens a window, showing all the antennas used in the current project. Now a specific antenna can be selected and the view will change to the antenna residence.

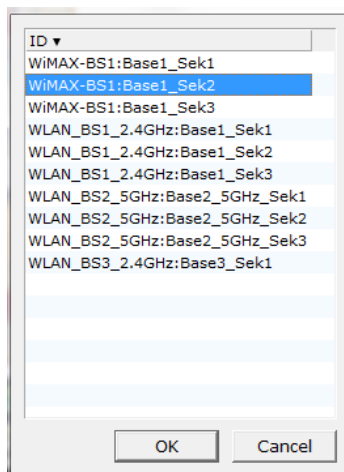


Figure 455: Choose the desired antenna

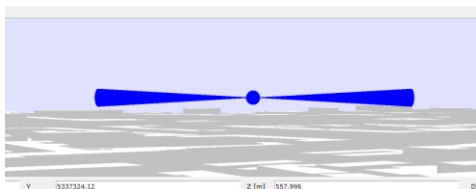


Figure 456: The antenna will be focused

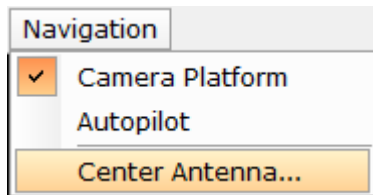


Figure 457: Navigation specials: Center Antenna

14.3 Export a 3D View

A 3D view can also be exported.



14.3.1 How to Export a 3D View

Assuming that a 3D view has been created. The export of a 3D view is only possible from within the 3D view window.

1. Choose **Plot**→**Export**.

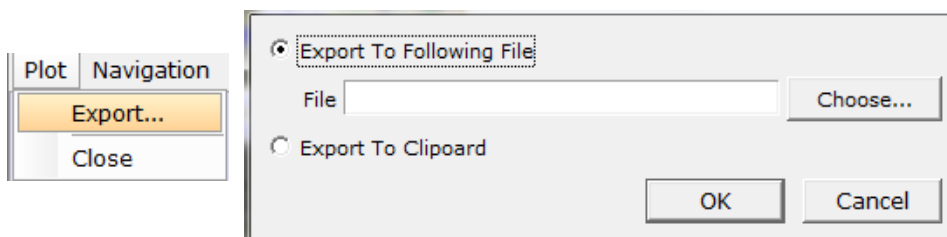


Figure 458: Export of a 3D View

2. Decide to export the picture directly to a file or to the clipboard.

The clipboard option allows the user to paste the picture in another program, for example, Microsoft Word. If you want to export the picture directly to a file, *choose a filepath by entering the path or click on **Choose** to navigate through the computer. Click on **OK** to export the picture.*

A .png file is saved at the specific filepath now and can be opened with every program that supports the .png format.

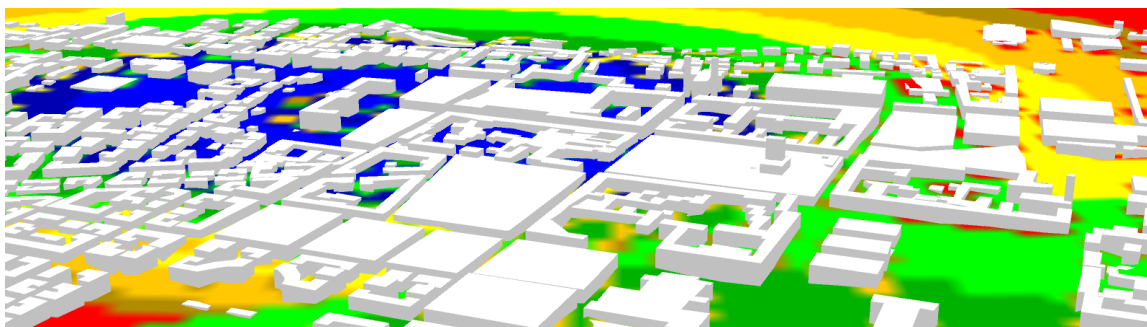


Figure 459: Exported .png

15 Glossary

3D view: It is possible to create a 3D view of the current project in WiMAP-4G. A better observation is possible with the help of the 3D view. Calculation results will also be shown in the 3D view.

Antennas: WiMAP-4G supports every kind of antenna (for example omni, yagi). Antennas will be considered with the help of antenna diagrams. These diagrams contain a detailed description of the vertical and horizontal attenuation which will be provided by the manufacturer in most cases. Antenna information can be imported in several ways (Planet-format) like .dat, .adf, .msi. Each antenna needs to be assigned to exactly one antenna type.

Background Image: Background images can be imported in WiMAP-4G. They can hold all desired information, for example satellite photography of the calculated terrain. The orientation will become much better with a background image showing the actual surface, buildings, wood etc. WiMAP-4G supports .tif, .tiff, .jpg and .png format for a background image import.

Best Server: With the help of the best server calculation, it can be determined which site (best server) offers the best signal for a specific area.

Building Classes: For a better overview, WiMAP-4G offers the possibility to arrange buildings in building classes. This is also necessary to create advanced buildings with towers or courtyards. Building classes can be differentiated by colours.

C/I: The carrier-to-interference ratio (C/I, CIR) is the quotient between the average received modulated carrier power S or C and the average received co-channel interference power I , i.e. cross-talk, from other transmitters than the useful signal.

Cadastral Data: Cadastral Data is vectored graphical information which typically consists of many layers. Cadastral data is used to get an overview on the environment and especially on buildings and boundaries in the project. WiMAP-4G supports the .dxf format. Cadastral data can be purchased from the local land survey register.

Calculation Layer: After a field strength calculation has been done, the results are conditioned and can be presented in different ways. These results will be constantly available, even in case of changing some network parameters. It is also possible to make different field strength calculations for different network parameters. The results can be activated at the calculation layer at any time. To obtain a good overview, calculations are

always temporary and will be deleted after making a new calculation of the same type. To keep a calculation available at any time, it can be saved in the calculation tab of the Project-Explorer.

Carrier: In telecommunication a carrier wave or carrier is a waveform that is modulated with an input signal for the purpose of conveying information. This carrier wave is usually of much higher frequency than the input signal. The purpose of the carrier is usually either to transmit the information through space as an electromagnetic wave or to allow several carriers at different frequencies to share a common physical transmission medium by frequency division multiplexing.

Client: A client is usually used to refer to a current or potential buyer or user of the connection.

Community-Edition: The Community-Edition is the free version of WiMAP-4G. It offers all the important features but with certain limitations, for example, only 12 antennas in the same project. The Community-Edition was released to give potential customers a good overview on the flexibility of WiMAP-4G.

CORINE: The CORINE land cover is referring to an European program establishing a computerized inventory on land cover of the 27 EC member states and other European countries, at an original scale of 1:100.000, using 44 classes of the 3-level CORINE nomenclature. It is produced by the European Environment Agency and its member countries and is based on the results of IMAGE2000, a satellite imaging program undertaken jointly by the Joint Research Centre of the European Commission and the EEA. CORINE data can be downloaded from the EEA-Website.

Coverage: Based on the field strength calculation results that can be achieved by clicking Calculation→Field Strength Area Calculation, the coverage can be displayed.

Elevation Model: Elevation models describe the topography of the ground surface. The elevation model is represented as a raster with a fixed cell size. The cell size characterizes the quality of the elevation model. A smaller cell size results in a higher precision. The elevation model is a very critical part of the project because imprecise data can cause problems, not during planning but in reality. Always try to find a highly precise elevation model to get the best results possible. The Terrain-Profiler cannot work properly without an elevation model.

Field Strength: The field strength is the quantitative expression of an electric field on a specific point. The unit is volt per meter (V/m). The strength of the electric field depends on

many factors especially the transmission power, the distance between station and receiver and inferences between those. With these parameters, the field strength can also differ on the same location, probably influenced by weather effects or vegetation. To prevent malfunction, WiMAP-4G always calculates the average achieved field strength. All themes are based on a field strength calculation which needs to be made before calculating, for example the power level or carrier to interferer.

Field Strength Area Calculation: WiMAP-4G offers two different kinds of field strength calculations. The field strength area calculation shows the field strength prognostic for every pixel in a huge area. However the point field strength calculation offers a field strength prognostic for specific denoted points (for example potential customer locations).

Geodata: Geodata are computerized geographical information which can help the user to get a better overview of the environment and the buildings in the project area. There are many types of geodata available on the internet. Special data like elevation models or cadastral data can be imported and used in WiMAP-4G projects. These data sometimes need to be purchased due to the high expense of creating them. Therefore they are very precise and qualified to be used in WiMAP-4G to achieve better results.

Graphic: Graphics in WiMAP-4G include all details associated with georeferenced display of background data, network and calculation results. These are displayed in the Project- and Terrain-Explorer and can be printed and plotted.

Isolines: An isoline is drawn around an area that contains the same value of a parameter. WiMAP-4G supports isolines for all calculation that have a graphical output. Isolines can also be exported and imported in other programs that support the .mif or .kml format.

Layer: WiMAP-4G works with layers. That means that every information, calculation, structure is drawn or calculated in its own layer which can be activated respectively deactivated for a better overview. The Project-Explorer holds a tab called the layer tab. This layer tab lists all the layers used in the current project and every layer can be checked or unchecked. Every action or import adds a separate layer.

License: A license is required for the Professional-Edition. It can be ordered at the WiMAP-4G product support. Latest pricing information are available at www.wimap-4g.com. Contact info@brown-iposs.eu for more information and for ordering a license.

Log: While making calculations with WiMAP-4G, many different things are done in the background, invisible for the user. The background actions will be protocolled and shown in the log. If an error occurs or a calculation does not seem to offer proper results, the log may

throw out some exceptions or warnings. With the help of these exceptions or warnings, it is sometimes possible for the user to fix the problems.

Network: A network contains all the locations and sites with their corresponding antennas.

Point: Among the sites, WiMAP-4G supports another essential data type: the points. Points can be used to get an overview on special places like potential customer locations or other site locations for the future. There are calculations for these points to check, for instance the field strength on a special place or area.

Point Categories: To create different types of points, WiMAP-4G offers the possibility to create point categories. This helps the user to differentiate the points.

Power Level: To rate the coverage on a specific point, it is necessary to determine the power level on that area. The power level calculates the power received from a normal receiver for the observed system at the radio frequency input in dBm.

Professional-Edition: The Professional-Edition is the purchased version of WiMAP-4G. It offers all features of the Community-Edition plus additional features, for example, more antenna pattern. There are no limitations in the Professional-Edition which make it the perfect tool to plan even large projects.

Project: A project includes a network which consists of all locations with their systems (for example WLAN, WiMAX...), antennas and the included data (for example geodata, background image...). A project also includes all settings done within it (for example propagation settings or graphical settings).

Site: A site is a base station holding active antennas. This can include many different systems, carrier and antennas.

Site to Site: Connecting two sites requires a fixed network connection or a dedicated wireless interface. Sites with a direct connection to the core network are named master sites. Sites which have no directly connection to the core network are called clients. For clients it is important to come down with a good radio link (most if the time with beam radio), to redirect all incoming traffic to a master site. The master site finally transfers all incoming data to the core network. Connections between sites are called site-to-site connection. WiMAP-4G offers the possibility to make a site-to-site calculation to determine the path loss between two sites. This can be useful to decide whether two sites can cooperate in a specific area or not.

System: In most cases, a network consists of different system technology, in short "systems". Especially for last mile connections, many different types of hardware and frequencies are in use (for example WLAN based on the 802.11a standard) compared to the connections between the sites (they will be connected for example with a radio relay system based on the 802.16a standard).

Terrain-Profiler: The Terrain-Profiler is a useful tool to get an overview of the environment and the elevation of the project. It can be used in several ways. The main aspect of the Terrain-Profiler is the ability to detect problems in the terrain while linking two sites. The Terrain-Profiler is a drag and drop tool which detects buildings, mountains or even trees that could interfere the connection. It is also possible to start a link budget calculation with the Terrain-Profiler. Results can be plotted or exported for presentations.

Themes: WiMAP-4G offers a lot of possibilities to visualize or display georeferenced results of field strength calculations and the resulting conclusions (for example coverage, power level...).

16 FAQ

16.1.1 What is WiMAP-4G?

WiMAP-4G is the radio network planning tool by brown-iposs. It offers a simplified, engaging way to plan, investigate, manage and analyse wireless networks.

16.1.2 Does WiMAP-4G supports 64-bit operating systems?

Yes, on Windows 64-bit OS versions. To start the 64-bit version please select "wimap-4g-64bit.exe" instead of "wimap-4g.exe". A 64-bit Java Runtime Environment is included in WiMAP-4G.

16.1.3 Which languages does WiMAP-4G support?

In the current version, WiMAP-4G supports English language only. Other languages can be supported on request.

16.1.4 Do I have to be online to use WiMAP-4G?

No, but: You need to be online to get a license for your WiMAP-4G installation. An internet connection is also necessary if you want to use OpenStreetMap™ to plan your maps. Additional satellite photos and elevation models can be downloaded from within the program if an internet connection is available.

16.1.5 What file formats does WiMAP-4G support?

File format	Use
.rap	project import/export, save/load projects
.dxf	cadastral data import
.asc, .asg	elevation data import
.gif, .tif, .tiff, .png	background image export/import plot, Terrain-Profiler diagram export 3D-view export
.mif	import/export buildings/structures export isolines
.shp	CORINE data import
.csv	antennas/points import/export
.kml	plot export
.zip	calculation import/export
.msi, .dat, .adf	antenna pattern import/export

Table 2: File formats supported by WiMAP-4G

16.1.6 How much does WiMAP-4G cost?

The costs of WiMAP-4G depend on the used edition, number of licenses and selected propagation models that shall be planned with WiMAP-4G. Since there is no constant price for all these features, a detailed price list can be obtained from the WiMAP-4G website.

16.1.7 What is the difference between WiMAP-4G Editions?

The Professional-Edition offers the complete feature set, apart from services that need to be licensed against third parties. The Community-Edition has additional project orientated limitations. The number of sites and of points in the same project is limited. Also the resolution for displaying the calculation results is limited and parts of the import/export functions are inaccessible. We reserve us the right to restrict new and more functionalities in future releases of WiMAP-4G Community-Edition.

16.1.8 What are the requirements to get a license?

Activation is necessary for the Professional-Edition as well as for the Community-Edition. After purchasing the WiMAP-4G Professional-Edition, a USB-dongle carrying the license will be delivered to you for the activation of your Professional-Edition. The Community-Edition also needs activation, but the only requirement is a valid e-mail address because we send the license file by e-mail.

16.1.9 Can I upgrade my Community-Edition to Professional-Edition at a later date within the program?

Yes, it is possible to use the Community-Edition and make an upgrade at any date later. It is sufficient just to plug in the USB-dongle (having the CodeMeter runtime environment installed) into your computer and start WiMAP-4G.

16.1.10 Do I have to update my WiMAP-4G from time to time?

WiMAP-4G will automatically search for updates from time to time. If a new update has been found, WiMAP-4G will ask you to download and install the update.

17 Troubleshooting

P: I cannot install WiMAP-4G: You do not have the required permission to run this file.

S: Administrative permission is needed to install WiMAP-4G. Please contact your system administrator for further information.

P: WiMAP-4G does not start.

S1: Check out if you have the right permission to run this program. Contact your system administrator for further instructions.

S2: Installation may be broken, try to reinstall WiMAP-4G.

P: I cannot activate my Professional-Edition: Your license file is damaged.

S: Your license file is not valid. Activation by license file (like done for Community edition) is no longer supported. Please contact info@brown-iposs.eu for a new license file.

P: CORINE does not show any data.

S1: The CORINE data is corrupted. Please contact the EEA for a solution.

S2: The CORINE data does not contain any information for the actual content (the blue frame). Make sure that the downloaded CORINE data is valid for your project.

P: Calculation takes very long time.

S1: If the workstation is an older one, calculation can take some time due to the hardware that is used. Try a faster system to get a faster calculation.

S2: Try another quality for the calculation. A higher precision takes a lot more time to calculate. Make sure that the used precision level is in need for your requirements.

P: New preconfigured Project: I cannot find the desired place via specified address.

S1: Try other keywords for your desired place.

S2: Try also zip codes.

S3: Take another place near the desired one and choose a bigger frame for the project.

P: Not enough memory for calculation.

S1: This usually happens while making calculation with very high quality on a low memory machine. Making a detailed calculation using the CORLA Raylauncher can consume far more than 4 Gigabyte of RAM.

S2: The used memory can be set to a specific maximum value in the



wimap-4g.vmoptions

Open the file using the windows editor and change the maximum Java heap size.

P: OpenStreetMap™: Tile X/Y/Z could not be loaded.

S: OpenStreetMap™ is not reachable at the moment. Check your internet connection or try it again later. This can also indicate a problem with your firewall. Contact your system administrator for further information or support.

P: I cannot use CORLA Raylauncher.

S: Since the CORLA Raylauncher is not a brown-iposs application, it is a third party software and needs a license to work for every special scenario. If you need a license, contact info@brown-iposs.eu for further information.

P: Cadastral data does not show up after import.

S1: Make sure the cadastral data layers are activated. Check the layer tab in the Project-Explorer.

S2: Cadastral data needs specific coordinates while import. If you do not have specified any coordinates for the cadastral data position, it can be found at the coordinates 0,0.

P: Building intersects buildings of the same type

S: This usually happens if you want to construct buildings inside other buildings using the same building class. Create a new building class and use that new one while construct the new building inside the old one.

P: Points does not shown up in the points tab.

S: Make sure that the right point-category has been chosen on top of the point tab in the Project-Explorer.

P: Antenna Pattern: An I/O error occurred due to following reason: Pattern "....." could not be read.

S: The antenna pattern is corrupt. Depending on the source off the file, contact the manufacturer of the antenna for a new pattern. You can also try to repair the corrupt file.

Detailed instructions in how an antenna patten should look like can be found in chapter 7.1.5.

P: Load Project: org.xml.sax.SAXParseException: Premature end of file.

S: The project file is damaged.

P: Load Cadastral: An I/O error occurred due to following reason: Error encountered in line -x: Unexpected EOF encountered in line -x.

S: The cadastral data file is damaged. Depending on the source, get a new fresh file and try it again.

P: Load Corine: An I/O error occurred due to following reason: Premature end of header.

S: The CORINE file is damaged. Depending on the source, get a new fresh file and try it again.

P: Specified Address: An I/O Error occurred due to following reason: gazetteer.openstreetmap.org

S: Check your internet connection. Connection to OpenStreetMap™ cannot be established. If your internet connection is working, the OpenStreetMap server is down at the moment. Try again later.

P: An internal error has been detected.

S: WiMAP-4G always saves a copy of the error in the folder WiMAP-4G/Profile. Feel free to send this error report to info@brown-iposs.eu.

P: I cannot choose a calculation from the menu.

S: A field strength area calculation needs to be done to enable other calculations. Choose **Calculation->Field Strength Area Calculation**.

P: The Elevation Model does not load, by a created project: An I/O Error occurred due to following reason: [Data Path] (The system cannot find the data path).

S: Delete the folder of the data path. If the path cannot found, search for hidden folder. After deletion, the project could be imported again.

P: I cannot select antennas and carriers (lists are empty)

S: Delete the default.rad data in C:\Users\"UserName"\AppData\Roaming\bips\WiMAP-4G. If the path cannot be found, search for hidden folder.

P: Starting calculation: An internal error has been detected!

S: Check whether all sites are inside the blue area (Elevation Model).

18 Image directory

Figure 1: The WiMAP-4G working interface.....	12
Figure 2: The Professional-Edition offers CORLA as an additional propagation model.....	14
Figure 3: Installation has been started	15
Figure 4: Installation directory.....	15
Figure 5: Start menu folder selection	16
Figure 6: Program icon location	16
Figure 7: License agreement	17
Figure 8: Program edition/License request.....	17
Figure 9: Choose location of your license file	18
Figure 10: Global Settings	18
Figure 11: Startup menu.....	19
Figure 12: Database menu	19
Figure 13: Plot menu	20
Figure 14: Plot -> Export menu	20
Figure 15: Units menu	21
Figure 16: Check for New Version menu.....	22
Figure 17: WiMAP-4G launches for the first time	23
Figure 18: Demo project "Munich"	24
Figure 19: Graphical user interface/work area.....	25
Figure 20: Cursor Point.....	28
Figure 21: Rectangle Zoom	29
Figure 22: Mark an area.....	29
Figure 23: Distance/measurement tool.....	30
Figure 24: The Terrain-Profiler looks like the distance/measurement tool.	31
Figure 25: The Terrain-Profiler tab.....	31
Figure 26: The Fresnel Zone is interrupted.	31
Figure 27: The Terrain-Profiler configuration menu	32
Figure 28: Change title, font and colour	32
Figure 29: The plot menu.....	33
Figure 30: Disabled tick labels	33
Figure 31: Enabled tick labels.....	33
Figure 32: Enabled tick marks	33
Figure 33: Disabled tick marks.....	33
Figure 34: The range tab	34
Figure 35: The appearance tab.....	34
Figure 36: The other tab.....	34
Figure 37: Anti-aliasing enabled.....	35
Figure 38: Anti-aliasing disabled	35
Figure 39: A configured Terrain-Profiler tab.....	35
Figure 40: Terrain-Profiler zoom functions	36
Figure 41: A plot can be saved or printed.	36

Figure 42: The printer window.....	36
Figure 43: The plot can be saved as a .png-file.	37
Figure 44: Transfixing the windows results in a much bigger work area	38
Figure 45: The Project-Explorer	39
Figure 46: The Sites tab.....	40
Figure 47: The Layers tab	41
Figure 48: Buildings layer enabled and disabled	41
Figure 49: All used points will be shown in a list.....	42
Figure 50: The Points tab – Coverage	43
Figure 51: The Points tab – Visualisation	43
Figure 52: The Calculation tab.....	44
Figure 53: The Elevation Model tab.....	44
Figure 54: The Cadastral Data tab	45
Figure 55: The Clients tab	45
Figure 56: The Link Budget tab	46
Figure 57: The General Settings tab.....	47
Figure 58: Bilinear interpolation	48
Figure 59: Nearest neighbour	48
Figure 60: The Calculation Settings tab	49
Figure 61: The Theme Settings tab.....	50
Figure 62: Selecting a theme.....	50
Figure 63: Selecting the desired theme	50
Figure 64: A changed profile	51
Figure 65: Selecting a theme.....	51
Figure 66: Click on New	51
Figure 67: Click Add to add new intervals	52
Figure 68: Fill in all fields	52
Figure 69: The created profile appears in the list.....	52
Figure 70: The Empirical Models Settings tab.....	53
Figure 71: The Free Space Propagation Settings tab.....	54
Figure 72: Choose free space propagation model	55
Figure 73: Click Add to add new parameters.....	55
Figure 74: Pathloss exponents and factor	55
Figure 75: The ITU-R P.1411-3 settings tab.....	56
Figure 76: The Erceg Model Settings tab	57
Figure 77: Elevation model visibility	58
Figure 78: Visibility of empirical models.....	59
Figure 79: Click Add to add new parameters.....	59
Figure 80: Fill in all fields	59
Figure 81: Click OK to save the changes.....	60
Figure 82: The created parameter appears in the list.....	60
Figure 83: The CORLA Settings tab	60
Figure 84: The CORLA Algorithm tab.....	61
Figure 85: The CORLA Model Parameters tab.....	62
Figure 86: The WinProp properties.....	63

Figure 87: The Elevation Model settings	64
Figure 88: The Building Classes settings	65
Figure 89: Select building classes	65
Figure 90: Click Add to add a new building class	65
Figure 91: Click OK to save the changes	66
Figure 92: Add new attenuation parameters	66
Figure 93: Save the changes with OK	66
Figure 94: Colours need to be added	66
Figure 95: Click OK to save all changes	67
Figure 96: The start dialogue	67
Figure 97: Create a new project	68
Figure 98: Dialogue for creating a project	68
Figure 99: Choose this type and click Next	69
Figure 100: Specify an area by address	69
Figure 101: Choose a result from the list	70
Figure 102: Specify an area by coordinates	70
Figure 103: Choose the radius of the area	71
Figure 104: Choose an example site	71
Figure 105: Open Google Maps™	72
Figure 106: Right-click the red marker	72
Figure 107: The coordinates	72
Figure 108: Choose a coordinate system type	73
Figure 109: The easy way to load projects	74
Figure 110: The log window	75
Figure 111: Errors are shown in red in the log window.	75
Figure 112: Load cadastral data	76
Figure 113: Choose a file	77
Figure 114: Add the cadastral data to the project	77
Figure 115: Unmodified cadastral data	78
Figure 116: Additional cadastral layers	78
Figure 117: DXF settings	79
Figure 118: Edit cadastral data layers	79
Figure 119: Choose Visualisation or Ignore	80
Figure 120: Edited cadastral layers	80
Figure 121: Cadastral data changed colour	81
Figure 122: The Cadastral Data tab	81
Figure 123: Load an elevation model	82
Figure 124: The elevation model tab after importing elevation models	82
Figure 125: Reload elevation model from web	82
Figure 126: Replace the current elevation model	83
Figure 127: Choose Radius for the new model	83
Figure 128: The new model will replace the old one	83
Figure 129: The import dialogue for a background image	84
Figure 130: Load a background image.	84
Figure 131: Fill in all fields and click OK	84

Figure 132: Import of location images.....	85
Figure 133: Import of one file.....	85
Figure 134: Import of more than one file.....	86
Figure 135: Imported location images are shown on the map	86
Figure 136: Show a location image	87
Figure 137: Browse or rotate location images	88
Figure 138: Delete location images from menu	88
Figure 139: Choosing the image layer	89
Figure 140: Delete location image from context menu	89
Figure 141: Import of location images.....	89
Figure 142: The import as background image	90
Figure 143: ITU-R P.1411-3 field strength calculation including buildings	91
Figure 144: ITU-R P.1411-3 field strength calculation without buildings	91
Figure 145: Capture buildings.....	92
Figure 146: Add the first coordinates.	93
Figure 147: The blue dot shows the coordinates.	94
Figure 148: All coordinates added.....	94
Figure 149: A created building.....	95
Figure 150: Add all corners	95
Figure 151: Building added via drag and drop.....	96
Figure 152: Add the courtyard.....	96
Figure 153: Courtyard.....	96
Figure 154: Intersecting buildings of the same type is not possible.....	97
Figure 155: Building classes	97
Figure 156: Capture buildings.....	97
Figure 157: A new building.....	98
Figure 158: Intersecting buildings and wood.....	98
Figure 159: Building in a building.....	98
Figure 160: Context menu of a building.....	99
Figure 161: Edit building window	99
Figure 162: Choose Save Buildings to export buildings.....	100
Figure 163: Choose Load Buildings to import buildings	100
Figure 164: Create buildings from cadastral data.....	101
Figure 165: Import settings.....	101
Figure 166: Buildings created from cadastral data	102
Figure 167: CORINE import.....	103
Figure 168: CORINE settings	103
Figure 169: Imported structures	104
Figure 170: CORINE imports need to be mapped to a building class	104
Figure 171: A whole region created with CORINE imports.....	105
Figure 172: Context menu of a building.....	105
Figure 173: Click Edit to show a list of all carriers.....	108
Figure 174: Choose New to create a new carrier	109
Figure 175: The Carrier Settings window	109
Figure 176: The fast way to create a carrier	110

Figure 177: Configured carrier	110
Figure 178: Coverage settings	110
Figure 179: Import carriers	111
Figure 180: Log information for the current import.....	111
Figure 181: Existing carriers cannot be replaced	112
Figure 182: Right-click in sites tab and click on New in context menu	114
Figure 183: Antenna Settings window	114
Figure 184: View of site with antenna on the map.....	115
Figure 185: Create antenna-types.....	115
Figure 186: Antenna-type settings with importing the antenna pattern	116
Figure 187: Antenna-type Settings.....	117
Figure 188: A pattern is required for antenna creation	117
Figure 189: Load single or multiple patterns	117
Figure 190: A valid pattern.....	118
Figure 191: Antenna attenuation	118
Figure 192: Right-click in sites tab and click on Edit in context menu	119
Figure 193: Antenna Settings window	119
Figure 194: Edit antenna-types.....	120
Figure 195: Antenna-type Settings.....	120
Figure 196: Right-click in the sites tab and click on Create Copy in context menu	121
Figure 197: Antenna settings of a copied antenna	122
Figure 198: Change multiple antennas	122
Figure 199: Choosing all antennas option	123
Figure 200: Setting the new carrier for all antennas	123
Figure 201: The windows editor.....	124
Figure 202: Editor with a few settings	125
Figure 203: Editor with attenuation parameters	126
Figure 204: Save the new file as .msi.....	127
Figure 205: Export antennas	127
Figure 206: Import antennas.....	128
Figure 207: Dialogue for setting the decimal separator	128
Figure 208: Imported antennas shown up on the map with their corresponding sites.....	128
Figure 209: Import antenna-types	129
Figure 210: Choosing file	129
Figure 211: Log information for the current import.....	129
Figure 212: Log with warning message	130
Figure 213: The sites tab	130
Figure 214: Invert activation of an antenna	131
Figure 215: Context menu for filter activation	132
Figure 216: Filter activation.....	132
Figure 217: Site settings with invalid antennas.....	133
Figure 218: Site tab with invalid antennas	133
Figure 219: Radio unit with invalid antennas.....	134
Figure 220: Invalid antenna	134
Figure 221: Log message about invalid antennas	135

Figure 222: Creating a new antenna	135
Figure 223: Radio unit with distributed antennas.....	136
Figure 224: Distributed antennas with same directions	136
Figure 225: Distributed antennas with different directions.....	137
Figure 226: Site Settings window	138
Figure 227: Radio unit settings window	139
Figure 228: Edit a radio unit.....	140
Figure 229: Copy a radio unit	141
Figure 230: Edit the radio unit.....	141
Figure 231: Radio unit settings for changing the carrier	142
Figure 232: List of carriers	143
Figure 233: Radio unit settings after adding another carrier	143
Figure 234: Change multiple radio units	144
Figure 235: Change multiple radio units window	144
Figure 236: Activate or deactivate all radio units	145
Figure 237: The sites tab	145
Figure 238: Site tab context menu for activation of a radio unit.....	146
Figure 239: Create empty or 3-sector example sites	147
Figure 240: Create a site on the map	147
Figure 241: Create a new site.....	148
Figure 242: Create a new radio unit.....	148
Figure 243: Radio Unit Settings window	149
Figure 244: Add antennas to the radio unit.....	150
Figure 245: Invalid antenna pattern.....	151
Figure 246: Create a new antenna-type	151
Figure 247: The created antenna in the list.....	152
Figure 248: The created site on the map	152
Figure 249: Select the site by right-click on the map or in the sites tab.	153
Figure 250: Edit the site and click OK to save changes.	154
Figure 251: Select the site by right-click in the sites tab.....	155
Figure 252: Site Settings window	155
Figure 253: Activate or deactivate all sites.....	156
Figure 254: The tool panel of sites tab	156
Figure 255: The Sites tab.....	157
Figure 256: Supported .csv file with measurement information.....	158
Figure 257: Measurement points from a measurement without colour information	159
Figure 258: Measurement points from a measurement coloured by visualisation	159
Figure 259: Measurement points from a measurement coloured by coverage	160
Figure 260: Edit point categories	161
Figure 261: Point category windows.....	162
Figure 262: Create new point categories	162
Figure 263: A new point category	163
Figure 264: New type and name.....	163
Figure 265: Save the new category.....	163
Figure 266: Create points from the menu	164

Figure 267: Create a point on the map.....	164
Figure 268: Create a point in the points tab.....	164
Figure 269: Choose a category	165
Figure 270: Fields for creating a point	165
Figure 271: The new point appears on the map.	166
Figure 272: Editing a point on the map	166
Figure 273: Editing a point with the help of the points tab	166
Figure 274: Edit the desired fields.....	167
Figure 275: Edit multiple points at once	167
Figure 276: Choose column and value	168
Figure 277: Slow way to activate/deactivate points	168
Figure 278: The tool panel of points tab.....	169
Figure 279: Export points as .csv file.....	169
Figure 280: Export points dialogue window.....	170
Figure 281: Export points as .kml file	170
Figure 282: Select path for export as .kml file.....	171
Figure 283: Import points	171
Figure 284: Import points dialog window.....	172
Figure 285: Set the types of parameters.....	172
Figure 286: left: Edit single point right: Edit multiple points	173
Figure 287: Choosing Points Colour from menu.....	174
Figure 288: Points Colour Setting.....	174
Figure 289: Convert points to client from menu	175
Figure 290: Create clients from points settings.....	175
Figure 291: Option Remove Points.....	176
Figure 292: The created clients appear on the map.....	176
Figure 293: The created clients on clients tab	176
Figure 294: Convert clients to points	176
Figure 295: Mark a client and choose Convert to Points	177
Figure 296: Remove clients after the conversion	177
Figure 297: The points appear on the map	177
Figure 298: The edit window of a point.....	178
Figure 299: Create new client profiles	179
Figure 300: Fill in all fields.....	180
Figure 301: Fill in all fields.....	180
Figure 302: Created carriers	181
Figure 303: Edit carriers.....	181
Figure 304: Create clients from the menu.....	182
Figure 305: Create clients on the map.....	182
Figure 306: Create clients from the clients tab	182
Figure 307: Fill in all fields.....	184
Figure 308: The client appears on the map.....	184
Figure 309: Edit clients from the menu.....	185
Figure 310: Edit clients in the clients tab	185
Figure 311: Choose the client and click on Edit.	185

Figure 312: Assign clients to the nearest site	186
Figure 313: Context menu of a client	186
Figure 314: Terrain-Profile between client and site	187
Figure 315: Invalid client on the map	187
Figure 316: Invalid client in the clients tab	187
Figure 317: Make a field strength area calculation.....	189
Figure 318: Field strength area calculation settings for the Erceg model.....	190
Figure 319: Calculation with Erceg model Type A	191
Figure 320: 50 % coverage probability	191
Figure 321: A field strength area calculation example: Munich, Erceg A, coverage probability: 50 %, resolution: absolute 5 m.....	192
Figure 322: Field strength area calculation settings for CORLA Raylauncher.....	193
Figure 323: Field strength area calculation settings for ITU-R P.1411-3.....	193
Figure 324: A field strength area calculation example: Munich, ITU-R P.1411-3, road orientation: 90°, resolution: absolute 5 m	194
Figure 325: Field strength area calculation settings for Free Space Propagation	194
Figure 326: A field strength area calculation example: Munich, Free Space Propagation, Resolution: absolute 5 m	195
Figure 327: WinProp field strength calculations settings.....	195
Figure 328: The clients tab in the Project-Explorer	197
Figure 329: Open the client coverage calculation settings	197
Figure 330: The coverage calculation settings.....	198
Figure 331: Calculation with Erceg model type A.....	199
Figure 332: 50 % coverage probability	199
Figure 333: A client coverage calculation example: Munich, Erceg A, coverage probability: 50 %	200
Figure 334: Client coverage calculation settings for CORLA	200
Figure 335: A client coverage calculation example: Munich, CORLA, resolution x/y: 3, resolution z: 3, point extent: 1	201
Figure 336: Client coverage calculation settings for ITU-R P.1411-3.....	202
Figure 337: A client coverage calculation example: Munich, ITU-R P.1411-3, road orientation: 90°	202
Figure 338: Client coverage calculation settings for Free Space Propagation	203
Figure 339: A client coverage calculation example: Munich, Free Space Propagation	203
Figure 340: WinProp field strength calculations settings.....	204
Figure 341: The points tab in the Project-Explorer.....	205
Figure 342: The points on the Terrain-Explorer	205
Figure 343: The points tab in the Project-Explorer with additional power level and field strength columns	206
Figure 344: Open the settings from menu	206
Figure 345: Open the settings from points tab	207
Figure 346: The point field strength calculation settings	207
Figure 347: Choose the type that fits the situation	208
Figure 348: 50 % coverage probability	209

Figure 349: A point field strength calculation example: Munich, Erceg A, coverage probability: 50 %, resolution: absolute 5 m	209
Figure 350: Point field strength calculation settings for CORLA	210
Figure 351: A point field strength calculation example: Munich, CORLA, resolution x/y: 3, resolution z: 3, point extent: 1	211
Figure 352: Point field strength calculation settings for ITU-R P.1411-3	211
Figure 353: A point field strength calculation example: Munich, ITU-R P.1411-3, road orientation: 90°	212
Figure 354: Point field strength calculation settings for Free Space Propagation	212
Figure 355: A point field strength calculation example: Munich, Free Space Propagation ..	213
Figure 356: WinProp field strength calculations settings	213
Figure 357: General settings for point field strength calculation	214
Figure 358: Open the point category settings	215
Figure 359: Columns for all propagation models	215
Figure 360: Make point field strength calculations for every propagation model	216
Figure 361: Comparison of the propagation models	217
Figure 362: Example for a site to site calculation	217
Figure 363: Start site to site calculation	218
Figure 364: Start site to site calculation from the map	218
Figure 365: The site to site calculation settings	218
Figure 366: Fill in all the fields and click OK to start the calculation	219
Figure 367: A black line signalizes problems	219
Figure 368: Create coverage theme from menu	220
Figure 369: Create coverage theme from Calculation tab	221
Figure 370: Create coverage theme from Calculation tab by right-clicking antennas	221
Figure 371: Coverage theme settings	222
Figure 372: A coverage theme example: Munich, 10 dB margin	222
Figure 373: A coverage theme example: Munich, 0 dB margin	223
Figure 374: Create best server theme from menu	224
Figure 375: Create best server theme from calculation tab	224
Figure 376: Create best server theme from calculation tab by right-clicking antennas	225
Figure 377: Best server theme settings	225
Figure 378: Munich: Field strength area calculation Erceg A	226
Figure 379: A best server theme example: Munich, 10 dB margin	226
Figure 380: A best server theme example: Munich, 0 dB margin	226
Figure 381: Create carrier to interferer theme from menu	227
Figure 382: Create carrier to interferer theme from calculation tab	228
Figure 383: Create carrier to interferer theme from calculation tab by right-clicking antennas	228
Figure 384: Carrier-to-interferer theme settings	229
Figure 385: Field strength area calculation Erceg A	229
Figure 386: A carrier-to-interferer theme example: 10 dB margin	230
Figure 387: A carrier-to-interferer theme example: 0 dB margin	230
Figure 388: Marker for the best C/I	230
Figure 389: Create power level theme from menu	231

Figure 390: Create power level theme from calculation tab	232
Figure 391: Create power level theme from calculation tab by right-clicking antennas	232
Figure 392: Power level theme settings	233
Figure 393: Munich: Field strength area calculation Erceg A	233
Figure 394: A power level theme example: Munich, 10 dB margin	234
Figure 395: A power level theme example: Munich, 0 dB margin	234
Figure 396: Marker for the best power level	234
Figure 397: Creating a sub-carrier interference theme from menu	235
Figure 398: Creating a sub-carrier interference theme from calculation tab	236
Figure 399: Creating a sub-carrier interference theme from calculation tab by right-clicking antennas	236
Figure 400: Sub-carrier interference theme settings	237
Figure 401: Munich: Field strength area calculation Erceg A	238
Figure 402: A sub carrier interference theme example: Munich, 0 dB margin	238
Figure 403: Marker for best sub-carrier interference	239
Figure 404: Create field strength theme from menu	239
Figure 405: Creating field strength theme from calculation tab	240
Figure 406: Creating field strength theme from calculation tab by right-clicking antennas.	240
Figure 407: Field strength theme settings	241
Figure 408: Munich: Field strength area calculation Erceg A	242
Figure 409: A field strength theme example: Munich, 0 dB margin, maximum load, peak level	242
Figure 410: A field strength theme example: Munich, 10 dB margin, maximum load, peak level	243
Figure 411: Marker for the best field strength	243
Figure 412: Creating an elevation theme from menu	244
Figure 413: Elevation theme settings	244
Figure 414: Elevation theme example, nearest neighbour, resolution relative 100 %	245
Figure 415: Elevation theme example, bilinear interpolation, resolution relative 100 %	245
Figure 416: Creating a visibility theme	246
Figure 417: Visibility theme settings	246
Figure 418: Visibility theme example, bilinear cellwise 1000, resolution relative 100 %	247
Figure 419: Clear the visibility layer	248
Figure 420: Submenu for elevation export	249
Figure 421: Available export (themes) formats (left: Professional-Edition right: Community-Edition)	249
Figure 422: Export settings by export as image	250
Figure 423: Clear the calculation layer	251
Figure 424: Delete calculation	252
Figure 425: Deletion of the actual calculation	252
Figure 426: Delete calculation with/without file	252
Figure 427: MIMO Mode Selection: Maximum Ratio Combining (MRC)	253
Figure 428: Calculation with Maximum Selection Combining (MSC)	254
Figure 429: Calculation with Maximum Ratio Combining (MRC)	254
Figure 430: Create isolines	255

Figure 431: Choose the states for the isolines.....	256
Figure 432: Theme isolines example, Munich, coverage.....	256
Figure 433: Create elevation isolines.....	257
Figure 434: Fill in the desired values.....	258
Figure 435: Elevation isolines example, Munich.....	258
Figure 436: Export isolines as .mif.....	259
Figure 437: Export isolines as .kml.....	259
Figure 438: Show on Google Maps.....	261
Figure 439: Right-click on Layers Tab.....	262
Figure 440: Filter Activation dialogue window.....	262
Figure 441: Settings of a site.....	263
Figure 442: Select the colour.....	264
Figure 443: Radio unit settings.....	264
Figure 444: Antenna settings.....	265
Figure 445: The Link Budget tab.....	267
Figure 446: The Link Budget tab.....	268
Figure 447: Select objects with Terrain-Profilr.....	269
Figure 448: The snap window appears after connecting two points.....	269
Figure 449: Link Budget calculation.....	270
Figure 450: Adjust antennas.....	270
Figure 451: Adjust antennas – select options.....	271
Figure 452: Create a 3D view.....	272
Figure 453: Example of a 3D view.....	272
Figure 454: Values for 3D-View.....	273
Figure 455: Choose the desired antenna.....	274
Figure 456: The antenna will be focused.....	274
Figure 457: Navigation specials: Center Antenna.....	275
Figure 458: Export of a 3D View.....	275
Figure 459: Exported .png.....	275